45.2	Number (For DM plant Option -2)	Two (1W +1S) (2X100%) - nos.for MB regeneration & Two (1W +1S) (2X100%) - nos.for pH control in RO	Two (1W +1S) (2X100%)- nos. for MB regeneration & Two (1W +1S) (2X100%)-nos. for pH control in RO
45.3	Type	---------- Simplex positive displacement type; hydraulically operated diaphragm type ----------	
45.4	Whether suction strainer required	---------- Yes ----------	
45.5	Capacity and head	As per System design	
45.5	Accessories	----------As Required----------	
45.6	Pressure Dampener	----------one for each pump ----------	
45.7	External safety relief valve (in addition to in-built safety valve)	----------one for each pump ----------	
45.8	Maximum pump stroke speed per minute	----------100 per minute----------	
45.9	**MATERIAL OF CONSTRUCTION**		
45.9.1	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.).	PVC	AISI:316
45.9.2	Diaphragm	PT.F.E.	P.T.F.E.
45.9.3	Packing	P.T.F.E.	P.T.F.E.
45.9.4	Shaft	---------- Hardened steel EN 8 (BS:970) ----------	
45.9.5	Worm & Worm Wheel (If Applicable)	----------Manganese Bronze----------	
45.9.6	Connecting Rod	----------Manganese Bronze----------	
45.9.7	Cross head Guide	---------- Bronze----------	
45.10	Capacity & Head	----------As per system requirement----------	
45.11	Hardware	Base plate: Fabricated Steel as per IS 2062, Bolts & Nuts SS 316.	
45.12	Instruments, Valves, Piping, etc	Shall be provided as indicated in 'Flow Diagram-1' as min and as per system requirement.	
46.0	**PIPING (FOR DM PLANT OPTION – I/ II)**		
46.1	Filtered water, Service Water	Stainless Steel: Stainless Steel ASTM A 312 Gr. 304 Sch. 40/ Equivalent Seamless for Sizes 50 and above and welded for sizes 65 mm NB and above.	
46.2	Demineralized water including UF, ACF and UF backwashed water.	**Stainless Steel:** Stainless steel to ASTM A312, Gr. 304 Sch.40s seamless for sizes 50mm and below and welded for sizes 65 mm NB and above.	
46.3	Decationised & Deanionsed water and N-pit waste	**Rubber lined Carbon Steel:** IS:1239 Part-I (Heavy Grade - Black), ASTM-A-53 Type-E Grade B / ASTM A 36 / IS:3589 – Grade 410;/ ASTM A-36/ASTM - 53 Type- E, Grade B/ Equivalent and Galvanized to IS: 4736 or Equivalent internally lined with 3 mm thick Rubber of shore hardness 65 ± 5 A) Note: The inside surface of pipes shall be completely de-beaded and made suitable for rubber lining	
46.4	Concentrated Hydrochloric Acid (5-30% Conc.)	CPVC Sch. 80 as per ASTM F441 CPVC 4120	
46.5	Dilute Hydrochloric Acid (Less than 5% Conc.)	CPVC Sch. 80 as per ASTM F441 CPVC 4120	
46.6	Alkali (Sodium Hydroxide) a) Strong (5% and above)	a) Stainless Steel SS-316L b) Polypropylene lined steel/CPVC as per ASTM F441	

	b) Dilute (below 5%)	CPVC 4120 Schedule 80
46.7	Lime slurry/Solution/ Suspensions	CPVC Sch. 80 as per ASTM F441 CPVC 4120
46.8	Cleaning Solution Line	SS316 Sch. 40/ CPVC Sch. 80 as per ASTM F441 CPVC 4120
46.9	Chemical Waste from vessels and tanks	CPVC Sch. 80 as per ASTM F441 CPVC 4120
46.10	Instrument air	CS Galvanized as per IS 1239 Gr. B Galvanized
46.11	UF frontal	CPVC, Sch-80.
47.0	**VALVES (FOR DM PLANT OPTION – I/ II)**	As specified somewhere else in this specification.
48.0	**SAFETY EQUIPMENTS (FOR DM PLANT OPTION – I/ II)**	Six sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. A personnel water drench safety shower with eye bath (2 Nos) shall be provided near acid alkali unloading/handling area.

49. UF-RO & MB PLANT

A	**Ultrafiltration unit (UF)**	
No	**Descriptions**	**Parameter /Data**
1)	Nos. of trains	2x60 %
2)	Feed Temperature	10-35 Deg C
3)	Recovery from UF	Not less than 92%
4)	UF Treated (Filtrate) Flow	Capacity of each UF to match with gross capacity of RO + water required for backwashing of UF+ Chemical preparation. Additional 5% margin over the total requirements
B	**Basket strainers**	
1)	MOC	SS-316
C	**UF permeate water storage tank**	
1)	Fluid to be Stored	Permeate Water produced from UF
2)	Type of Tanks	Vertical Cylindrical Atmospheric
3)	No of tanks	Two(2)
4)	Design Standard	IS : 803
5)	Effective capacity of Tank	Minimum 1 Hr. retention
6)	Material of construction	MS as per specified code
7)	Shell thickness	Bottom most layer : 10 mm (min.) Balance layer : 8 mm (min.)
8)	Bottom plate thickness	10 mm (minimum)
9)	Inside protection	Solvent free epoxy coating
10)	External painting	Epoxy coating.
11)	Accessories, Additional nozzle connections	REFER UF FEED TANK (OPTION-1) OF RESIN BASED DMP

D	**UF PERMEATE TRANSFER PUMPS**	
1	Type	Horizontal Centrifugal (With VFD)
2	Number	3X 50% (2W+1S)

3	Design Flow	To suit the gross capacity of RO system requirements
4	Rated head of pump in MWC	As per bidder's design
5	Location	Outdoor
6	Type of Casing	Radially Split type
7	Material of Construction	
7.1	Casing	ASTM A 351 CF8M
7.2	Impeller	ASTM A 351 CF8M
7.3	Wearing Rings	SS-316
7.4	Shaft, Shaft Sleeves, Coupling	SS-420
8	Duty	Continuous
9	Hardware	Base plate: Fabricated Steel as per IS 2062(Minimum 10 mm thick), Bolts & Nuts SS 316.
10	Instruments, Valves, Piping, etc	Shall be provided as indicated in 'Flow Diagram-2' as min and as per system requirement.
E	**UF BACKWASH WATER PUMPS**	
1	Type	Horizontal Centrifugal (With VFD)
2	Number	2X 100% (1W+1S)
3	Design Flow	As per Bidder's design
4	Rated head of pump in MWC	As per bidder's design
5	Location/Purpose	Outdoor/ For backwashing and CEB of UF skids
6	Type of Casing	Radially Split type
7	Material of Construction	
7.1	Casing	ASTM A 351 CF8M
7.2	Impeller	ASTM A 351 CF8M
7.3	Wearing Rings	SS-316
7.4	Shaft, Shaft Sleeves, Coupling	SS-420
8	Duty	Continuous
9	Hardware	Base plate: Fabricated Steel as per IS 2062(Minimum 10 mm thick), Bolts & Nuts SS 316.
10	Instruments, Valves, Piping, etc	Shall be provided as indicated in 'Flow Diagram-2' as min and as per system requirement.

50. CARTRIDGE FILTERS & RO TRAINS/STREAMS

A.	**Cartridge filters**	
1)	Filtration Capacity of each filter	Capacity one CF same as capacity of one (1) UF
2)	Numbers	One (1) for each RO stream with a common standby.
3)	Filter Casing & Internals	SS -316
B.	**RO trains /streams**	
1)	Number of trains	3x50% (2W+1S)
2)	Turn Down Capability	One or both the trains shall be operable as per requirement
3)	Design net capacity of each train (Permeate Flow)	Not less than 75 Cu.m/h
4)	Gross capacity of each train	Not less than 75 Cu.m/h +Internal consumption of RO system
5)	Number of Membrane (Block) per Train	One or more as per design
6)	No of Membranes per module	6 - 8
7)	Guaranteed Design Recovery	Not less than 85%
8)	Membrane type	Polyamide, Spiral wound
9)	Average Flux	<20 L/M^2h
10)	Fouling Allowance for design	Minimum 5% per year
11)	Salt passage increase	Minimum 10% per year
12)	End connectors	Victaulic coupling or equiv.(SS-316)
C.	**High pressure feed pump**	
1)	Purpose	To pump filtered water at the downstream of Cartridge filters up to the Degasser towers through RO trains.
2)	Number of pumps	One(1) per RO train
3)	Type of Pumps	Centrifugal with VFD
4)	Design flow rate of each Pump	To suit the Gross capacity of each RO train
5)	Rated Head	1.10 x (RO train Feed Pressure + frictional loss in the system)
6)	Service Duty	Continuous
7)	Type of pump casing	As per manufacturer's standard

D.	**RO Permeate water storage tanks**	
1)	Number required	Two (2)
2)	Effective Capacity of each tank	Minimum 1.5 Hr. retention
3)	Type and Pr. class	Vertical cylindrical atmospheric.
4)	Design Standard	As per IS: 803
5)	Material of construction	MS as per specified code
6)	Shell thickness Bottom plate thickness	Bottom most layer : 10 mm (min.), Balance layer : 8 mm (min.) : 10 mm (min.)
7)	Inside protection	Solvent free epoxy coating.
8)	External painting	Epoxy coating.
9)	Accessories, Additional nozzle connections	REFER UF FEED TANK (OPTION-1) OF RESIN BASED DMP
E.	**CHEMICAL CLEANING SYSTEM**	
1.	**CHEMICAL TANKS**	
1)	Numbers Required	One (1)
2)	Effective Capacity	As per bidder's design
2.	**CHEMICAL CLEANING PUMPS**	
1)	Numbers Required	Two (2) (2x100%) (1W+1S)
2)	Type	Horizontal Centrifugal
3)	Design flow rate of each Pump	Suitable for cleaning of one (1) RO train/stream at a time.
F.	**FLUSHING SYSTEM**	
1)	Numbers of Flushing pumps Required	Two (2) (2x100%)
2)	Type	Horizontal Centrifugal
3)	Design flow rate of each Pump	Suitable for cleaning of one RO train/stream at a time
G.	**DEGASSER SYSTEM**	
1)	Degassed Tower, Degasser blower & pumps	Ref. for DM plant

51. MIXED BED (MB) POLISHER UNITS (RO PLANT)

1)	Type	Vertical shell type with dished ends
2)	Design flow per unit (net)	Not less than 75 m^3/hr
3)	Gross flow rate per MB unit	To be decided by bidder considering DM water required for regeneration.
4)	Service Cycle (period between two (2) successive regenerations)	30 hrs.
5)	Design surface flow rate at design flow	Not more than 35 M^3/M^2/hr
6)	Shell & dished end material	Mild steel as per specified code
7)	Shell lining	
	a)Material	Rubber
	b)Thickness	4.5 mm (minimum)
8)	External painting	Chlorinated rubber paint
9)	Manhole	Two (2) per vessel (Min.)
10)	Sight windows	Two (2) minimum per vessel (Minimum clear width shall be 75 mm)
11)	**Resins**	
	a)Type	Strongly acidic and strongly basic Type-I, both the resin shall be of high capacity polystyrene resins in bead form.
	b)Regeneration	By HCl and NaOH
	c)Total resin bed depth	1.0 M (min)
	b)Regeneration	By HCl and NaOH
	c)Total resin bed depth	1.0 M (min)
12)	**Air-blowers for Mixed Beds**	
	Number	Two (2x100%)
	Type	Centrifugal/Twin lobe type
	Capacity & Head	As required

52. DATA SHEET FOR UF/RO OTHER SYSTEM

A.	SMBS & Antiscalant dosing system		
1)		SMBS dosing tank	Anti scalant dosing tank
	No of tanks	2 W	2W
	Capacity	500 Lit (Min)	500 Lit (Min)
	MOC	MSRL / FRP	MSRL / FRP
	Tank Mixer/Agitator	Turbine Agitator	Turbine Agitator
	MOC of Mixer/Agitator	SS-316	SS-316
2)		SMBS dosing pumps	Antiscalant dosing pumps
	No.	2(1W+1S)	2(1W+1S)
	Type	Positive displacement	Positive displacement
	MOC	PP	PP

53. RO REJECT TRANSFER PUMPS

A	RO REJECT TRANSFER PUMPS	
1	Type	Horizontal Centrifugal/ Vertical Centrifugal
2	Number	2X 100% (1W+1S)
3	Design Flow/capacity of each pump	As per system requirement
4	Rated head of pump in MWC	As per system requirement
5	Location	Outdoor
6	Material of Construction of Pumps	Duplex SS
7	Duty	Continuous
8	Hardware	Base plate: Fabricated Steel as per IS 2062(Minimum 10 mm thick), Bolts & Nuts SS 316.
9	Instruments, Valves, Piping, etc	Shall be provided as indicated in 'Flow Diagram-2' as min and as per system requirement.
9	Hardware	Base plate: Fabricated Steel as per IS 2062(Minimum 10 mm thick), Bolts & Nuts SS 316.
10	Instruments, Valves, Piping, etc	Shall be provided as indicated in 'Flow Diagram-2' as min and as per system requirement.
B	**RO REJECT COLLECTION SUMP**	
1	Quantity	One (1)
2	Type	Rectangular in cross section
3	Type of fluid to be handled	RO Reject water
4	Effective Capacity	2 hours retention for RO working streams
5	Free board	300 mm
6	Material of construction	RCC with suitable lining

TECHNICAL DATA SHEET-A FOR CHAIN PULLEY BLOCKS WITH / WITHOUT TROLLEY		
A. GENERAL INFORMATION		
1	Type	Chain pulley block with/ without travelling trolley
2	Design	As per IS: 3832
i)	Selection criteria	Chain pulley block of suitable capacity, lift, and travel length shall be provided for handling of items weighing from 500kg upto 1.6T and / or having lifting height less than 10m. The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled.
3	Duty Class	Class –2 as per IS: 3832
B. TECHNICAL PARAMETERS / DESIGN FEATURES		
4	**Hoisting Mechanism**	
a)	Type	Hand operated gear transmission
b)	Hook	Point hooks with shank, as per IS: 15560, swivelling with safety latch
c)	Hook bearing	Thrust ball bearing of hook suspension
d)	Gears / pinion	Spur / Helical
i)	Material	As per IS 3832
ii)	Type of bearing used	Antifriction ball bearing / Roller
e)	Ratchet Pawl & Wheel	
i)	Material	Steel, hardened and tempered
ii)	Hardness	The hardness of the pawl tip shall not be less than 40HRC and that of ratchet is not less than 30HRC.
iii)	Type of bearing used	Antifriction ball bearing / Roller
f)	Load Chain	Link type, T (8), As per ISO: 3077 / IS-3109/IS-6216
g)	Load chain wheel material	As per IS 3832 / pressed steel
h)	Hand Chain (For hoist)	Link type, Mild steel (grade 30) as per IS 2429 Part I / II
i)	Hand chain wheel (with flanges) material	As per IS 3832 / pressed steel
j)	Method of lubrications	Grease
k)	Brakes	Screw and friction disc type
5	**Trolley & Bridge Drive**	**(Applicable for CPB with trolley only)**
a)	Trolley	Geared (Manually operated)
i)	Material of frame	Rolled structural steel (IS:2062 Grade A or B)
b)	Hand Chain For trolley	Link type, Mild steel (grade 30) as per IS 2429 Part I / II
c)	Trolley Wheel material	Carbon steel
i)	Type of bearing used	Antifriction ball bearing
d)	Gears / pinion	Spur / Helical
i)	Material	As per IS 3832
ii)	Type of bearing used	Antifriction ball bearing / Roller
e)	Method of lubrications	Grease
6	**SPECIFIC REQUIREMENT FOR CHAIN PULLEY BLOCKS FOR HAZARDOUS AREA:**	
a)	MOC for Ratchet wheel, chain guides and gears:	HTB2 / Solid construction in aluminium bronze or phosphor bronze

b)	MOC for hand chain wheel:	Solid construction/ rims of aluminium bronze or phosphor bronze / HTB2
c)	MOC for hand chain wheel guide	Solid construction in aluminium bronze or phosphor bronze / HTB2
d)	MOC for Un-geared & geared wheels	HTB2/PB-4 lining on trolley wheels
C. TESTING AND INSPECTION		
7	Inspection and Testing	As per Quality Plan.

DATA SHEET-A FOR ELECTRIC HOIST

S.N.	Description	Technical Particulars	
1	Name of the manufacturer	As per sub vendor list	
2	Design, fabrication and testing of the crane confirm to standard / code number	IS: 3938	
i)	Selection criteria	For handling of items weighing 2T and / or having lifting height more than 10m. The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled.	
3	Duty	Class II	
4	Suitable for indoor/ outdoor	Indoor duty	
5	Capacity (T), Lift (m) & travel (m)	Refer- TABLE-1	
6	Operation from	Pendent push button	
7	Design amb.	50 deg.	
8	Speed with full load	Full speed	Creep speed
a	Main Hoist (M/Min.)	3	* project specific
b	CT motion (M/Min.)	10	* project specific
9	**COMPONENT DETAILS**		
9.1	Structure	MS Fabricated	
9.2	Rope details		
a	Standard	IS:2266	
b	Construction	Extra flexible plough steel / 6 x 36 construction, Tensile designation min 1770 KN	
c	Factor of safety	As per IS 3938	
d	Type of core	Steel/ fibre	
9.3	Rope drum	Design as per IS 3938	
a	Material	Seamless pipe ASTM -106 Gr.A/ B	
b	Flange / flangeless	Flanged	
9.4	Sheaves details	Design as per IS 3938	
a	Material	Fe 410 WA IS: 2062 Gr. B / CS Gr. 280-520 IS: 1030 Design as per IS: 3938- 1999	
b	Type of guards provided	Fabricated from rolled steel plate	
9.5	Gear box details		
a.	Type of mounting of gear box	Horizontal / Vertical	
b.	Classification	Suitable for M5 duty	
d.	Type of gears	Spur/Helical	
e	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication	

f	Hardness (BHN)	as per IS 3938	
g.	Material(gear/pinions)	Main Gears EN 9/ 55C8/ IS2707 Gr. 1or 2. Pinions EN 19/EN 24.	
		Hardness conforming to IS: 3938 (latest edition)	
		Gears to be hardened, tempered & heat treated as per IS 4460	
h.	Gear box housing material	Cast / Fabricated & stress relieved	
I	Noise level	85 db	
j	Standard conforming to	IS: 4460 / AGMA	
9.6	Lifting hooks	Point hook with shank with safety latch Swivelling type as per IS: 15560. Material shall be class 1A / 3 as per IS 1875 for L/M grade hook respectively	
9.7	Brakes (Per motor)	Main Hoist	Cross travel
a	Type of brake	DCEM	DCEM
b	Number provided	1 no.	1 no.
c	Braking capacity of each brake	150% of rated torque	125% of rated torque
9.10	Wheels		
a.	Material	Grade C55Mn75 of IS 1570 (Part 1 and Part 2/Sec 2) or 42CrMo4 or equivalent as per IS 3938-2020.	
b.	Hardness	200 BHN	
c.	Process of hardening	Volume hardening	
d	Type	Single flanged	
e	Specification conforming to	IS: 3938	
f	Arrangement of lubrication	Grease	
9.11	**Buffers**		
a	**Type**	Spring loaded type. Buffers shall have sufficient energy absorbing capacity to bring unloaded crane / trolley (loaded crane in the case of stiff masted cranes) to rest from a speed of 50 percent of the rated speed at a deceleration rate not exceeding 5 m/s2.	
b	**Details of end stop**	MS	
9.12	**Bearings**	Antifriction ball / roller bearings (Life- 10,000 working hours.)	
10	Motors		
a	Type	Squirrel cage	
b	Enclosure	TEFC	
c	Voltage, phase and frequency	3 Ph, 4 wire, 415V ±10%, 50 Hz ±5% Combined voltage & frequency variation = 10% absolute	
d	Rated capacity (KW)	Motor rating shall be selected keeping margin of 15% over the maximum power requirement.	
e	Service class	S4	
f	Number of starts/ hour	150 starts / hr	
g	Pull out torque	The pull-out torque of the motor will not be less than 225 % of the full load torque.	
h	Qnty	For Main hoist: one no.	
		For Cross travel: one no.	
11	Power conductors (DSL) & Cables		

a.	Design Criteria	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 2% of rated voltage at motor terminals.
b.	Type	LT: PVC shrouded GI conductor bus bar. CT: Flexible trailing cable/ T- track arrangement
c.	LT POWER CABLES	XLPE insulated & PVC insulated
c.1	1.1 KV grade XLPE power cables	1.1 KV grade XLPE power cables shall have multi stranded compacted aluminium conductor (tensile strength of more than 100 N/ sq.mm), XLPE insulated, PVC inner-sheathed (black colour as per IS:5831), Armoured (For single core Armoured cables, armouring shall be of aluminium wires H4 grade. For multicore Armoured cables armouring shall be of galvanized steel round wire/strip), PVC FRLS outer-sheathed (black colour) conforming to IS: 7098. (Part-I).
c.2	1.1KV grade PVC power cables	1.1KV grade PVC power cables shall have multi stranded aluminium conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed ((black colour as per IS:5831)) Armoured (For single core Armoured cables, armouring shall be of aluminium wires H4 grade. For multicore Armoured cables armouring shall be of galvanized steel round wire/strip), PVC FRLS outer-sheathed (black colour) conforming to IS:1554 (Part-I).
c.3	LT Control Cables	LT Control Cables are Cu conductor 1.5 sq mm, PVC insulated, PVC inner sheath, GS wire/strip armoured and FRLS PVC outer sheath confirming to IS 1554 Part-1. Standard control cable sizes shall preferably be 3CX1.5, 5CX1.5, 7CX1.5 & 10CX1.5mm2, 14CX1.5 mm2.
c.4	1.1 kV grade trailing cables	1.1 kV grade trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame-retardant heavy-duty elastomeric compound conforming to IS 9968.
d.	Size	a) Rated current of the equipment b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage. c) Short circuit withstand capability Derating factors for various conditions of installations (variation in ambient temperature, grouping of cables) shall be considered while cable sizing. d) DSL shall be sized as it can cater max. load requirement for all cranes running on the same DSL

		+ 40% margin e) Min. power cable size shall be minimum 2.5 mm2 for Cu/ Minimum 6mm2 for Aluminium f) Min. power cable size shall be minimum 2.5 mm2	
e.	Length	Suitable for bay length	
12	Control panel		
a	Material	Rolled sheet steel 2mm size	
b	Numbers and location	One each for Protective, MH, AH, CT and LT located on bridge platform.	
c	Degree of Protection	IP 54	
d	Features	Each panel shall have internal illumination with fluorescent lamp and thermostat-controlled space heater, suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF Switches.	
13	Cable (Fixed)	Power	Control
a	Material	Stranded Copper/ Stranded Aluminium	Stranded Copper
b	Size	Minimum 2.5 mm2 for Cu/ Minimum 6mm2 for Aluminium	Minimum 1.5 mm2
c	Voltage grade	1100V grade PVC cables with extruded inner sheath	1100 Volt grade flexible, heat resistant, insulated switchboard wires
14	Limit switches		
a.	Type	For MH: Rotary gear + Gravity	
		For CT: Lever type (one way/ two way)	
b.	Number provided	For MH: 1+1	
		For CT: 2/1	
c	Control voltage / Enclosure	110 V/ IP 55	
15	Power Supply	One (1) no 415 V, 3 phase, 4 wire supply at operating floor at centre/end of bay through an isolation switch placed at 1.5 m from operating floor.	
17	Control Transformer	1 no, 415/110V (to be sized for 20% margin)	
18	Hand rail pipes	32 mm NB heavy duty GI pipes as per IS 1239 having top and bottom rail at height of 1000 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)	
19	Isolating switch		
a.	Main isolating cum changeover switch (01 no.), mushroom type emergency STOP push buttons at centre of bay length (to be decided during detail engineering). Additionally Two nos. maintenance isolator shall be placed at gantry girder level at suitable distance for maintenance of the cranes		
b.	BHEL will provide two number 415 V AC (3 PHASE 4 WIRE) supply feeder only up to isolating cum changeover switch. Any other voltage level (AC/DC) required will be derived by the vendor.		
c.	Motor starter shall be part of crane control panel.		
20	Earthing	G.I / Copper	
21	**Consumables**		

	The Bidder's scope includes requirements of consumables such as oils, lubricants including grease, servo fluids, cadmium compounds, gases and essential chemicals etc. Consumption of all these consumables till handing over shall also be included in the scope of the Bidder. Bidder shall also supply a quantity of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilized till handing over. This additional quantity shall be supplied in separate Containers.			
B	**Maintenance tools & tackles**	One set contains following		
	Item description	Qnty	UOM	
a.	Complete set of ring spanners	1	set	
b.	Complete set of screwdrivers (Min. 6 Nos., Indicate the sizes)	1	set	
c.	Adjustable Spanner	1	no.	
d.	Insulated plier	1	no.	
e.	Wrench spanner	1	no.	
f.	Grease Gun	1	no.	
g.	Oil Gun.	1	no.	
h.	Hand Lamp.	1	no.	
i.	Line tester	1	no.	
j.	O&M Manual	1	no.	
k.	Steel box to place above tools & manual	1	no.	
C	**Erection & Commissioning Spares**	One set contains following		
	Item description	Qnty	UOM	
a.	Oil seal for each gear box	2	nos.	
b.	Indicating lamps of each color	2	nos.	
c.	Push button of each type and rating	2	nos.	
d.	Auxiliary Contactor of each rating	2	nos.	
e.	Limit switches	2	set	
f.	Touch up paints for structural component	10	Ltr.	

SECTION- I B

SPECIFIC TECHNICAL REQUIRMENT-ELECTRICAL

ELECTRICAL EQUIPMENT SPECIFICATION

(SPECIFIC ELECTRICAL REQUIREMENT)

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per [Scope of Work (Electrical)].

2.0 Make of all electrical equipment/ items supplied shall be reputed make. Same shall be subject to approval of BHEL/customer after award of contract without any commercial implications. Tentative make list of various Electrical items (Motors/ lugs/glands) is attached.

3.0 All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

4.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

4.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated.

4.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

5.0 LIST OF ENCLOSURES

5.1 Electrical scope between BHEL & vendor
5.2 Technical specification - Motors
5.3 Datasheets –Motor
5.4 Blank.
5.5 Load data format
5.6 Blank.
5.7 Explanatory note for Cable routing & Cable schedule format

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM

PACKAGE: PTP/DMP/ETP/STP/CWT/CLO2/CHP Run off WTP/CPU
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW)

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	a) 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL as per load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. b) Emergency supply feeder provided (if required) shall be 3 phase 3 wire only. Any other voltage level (AC/DC/Single ph emergency AC) required will be derived by the vendor. c) 230 V AC UPS Power supply shall be provided by BHEL at a single point, All necessary hardware for deriving other power supply from given feeder shall be in Vendor's scope.
2	Local control panel	Vendor	Vendor	Refer C & I specification for details
3	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
4	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 4.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM

PACKAGE: PTP/DMP/ETP/STP/CWT/CLO2/CHP Run off WTP/CPU
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW)

5	Junction box for control & instrumentation cable (if applicable)	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
6	Cable trays, accessories & cable trays supporting system. 100/50 mm cable trays/Galvanised steel cable troughs for local cabling	BHEL BHEL	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs as per approved layout drawing during contract stage.
7	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
8	Equipment grounding	BHEL	BHEL	Within the skid. All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
9	Motors with base frame and fixing hardware for motors.	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
10	Cable glands, lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
11	Conduit and conduit accessories for cabling between equipments supplied by vendor.	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
12	Lighting	BHEL	BHEL	--
13	Below grade grounding	BHEL	BHEL	
14	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
15	Any other equipment/material/service required for completeness of system based on the system offered by	Vendor	Vendor	--

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM

PACKAGE: PTP/DMP/ETP/STP/CWT/CLO2/CHP Run off WTP/CPU
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW)

	vendor (to ensure trouble free and efficient operation of the system).			
16	Electrical Equipment GA drawing & skid GA drawing	Vendor	-	For necessary interface review.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM (FOR EPC PROJECTS)

PACKAGE: CDS/LDS/ODS
SCOPE OF VENDOR: SUPPLY

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	a) 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL as per load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. b) Emergency supply feeder provided (if required) shall be 3 phase 3 wire only. Any other voltage level (AC/DC/Single ph emergency AC) required will be derived by the vendor. c) 230 V AC UPS Power supply shall be provided by BHEL at a single point, All necessary hardware for deriving other power supply from given feeder shall be in Vendor's scope.
2	Local control panel	Vendor	Vendor*	Refer C & I specification for details (with in skid)
3	Local push buttons	BHEL	BHEL	If applicable
4	Power cables, ordinary control cables and screened control cables	Vendor	Vendor*	Within the skid. If starters are in MCC, then outside skid, cables scope shall be as per note no. 1.
5	Junction box for control & instrumentation cable (if applicable)	Vendor	Vendor*	Within Skid
6	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical	Vendor	Vendor*	Within the skid
7	Equipment grounding	BHEL	BHEL	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM (FOR EPC PROJECTS)

PACKAGE: CDS/LDS/ODS
SCOPE OF VENDOR: SUPPLY

8	Motors with base frame and fixing hardware for motors.	Vendor	Vendor*	Makes shall be subject to customer/ BHEL approval at contract stage.
9	Cable glands, lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor*	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
10	Below grade grounding	BHEL	BHEL	
11	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
12	Electrical Equipment GA drawing & skid GA drawing	Vendor	-	For necessary interface review.

NOTES:- 1. If motor starters are provided in main MCC then BHEL will provide power & control cable including supply, laying & termination.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

*E &C by vendor during factory assembling of the skid.

DATA SHEET OF MOTOR

TECHNICAL DATA - PART - A

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Three phase induction motors :		IS15999, IEC:60034, IS: 12615
1.2	Single phase AC motors		IS:996, IEC:60034
1.3	Energy Efficient motors		IS 12615, IEC:60034-30
1.4	Crane duty motors		IS:3177, IS/IEC:60034
1.5	Mechanical Vibration of Rotating Electrical Machines with Shaft Heights 56 mm and Higher - Measurement, Evaluation and Limits of Vibration Severity		IS 12075/IEC 60034-14
1.6	Designation of Methods of Cooling of Rotating Electrical Machines		IS 6362
1.7	Designation for types of construction and mounting arrangement of rotating electrical machines		IS 2253
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	Rated voltage	V	415
2.2	Frequency	Hz	50
2.3	Permissible variations for		
a)	Voltage	%	+/-10
b)	Frequency	%	(+)3 to (-)5
c)	Combined	%	10 (absolute sum)
2.40	System fault level at rated voltage for 1 sec	kA	50
2.4	Short time rating for terminal boxes for 0.25 sec	kA	50
2.5	Type of motors		a) Squirrel cage induction motor suitable for direct-on-line starting (for non- VFD motors). b) Motor operating through VFD shall be suitable for inverter duty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC:60034-18-41 and IEC:60034-18-42 as applicable.
2.6	Efficiency class		*Continuous duty LT motors upto 50 KW Output rating (at 50 deg.C ambient temperature), shall be super Premium Efficiency class-IE4, 50-200 KW shall be of Premium Efficiency class – IE3,conforming toIS 12615, or IEC:60034-30.*
2.8	Rating		
a)	Motor duty		Continously rated-S1
b)	Design margin over continous max. demand of the driven equipment (min)		10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.
3.0	**CONSTRUCTION FEATURES**		
3.1	Winding		Electrolytic grade Copper conductor
3.2	Enclosure Details		
a)	Degree of protection		
	i) Indoor motors		IP 55
	ii) Outdoor motors		IP 55 (Additional canopy to be provided).

b)	Method of ventilation		Totally enclosed fan cooled (TEFC) or totally enclosed tube or ventilated (TETV) or Closed air circuit air cooled (CACA) type.
3.3	Insulation		Class 'F' with temperature rise limited to class 'B'. Non-hygroscopic, oil resistant, flame resistant Insulation.
3.4	Bearings		Grease lubricated ball or roller bearings for Horizontal motors Grease lubricated ball or roller bearings or combined thrust and guide beaing for Vertical motors.
3.5	Main terminal box		
a)	Type		-Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation. -Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame. - The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
b)	DOP		Same as motor
c)	Position when veiwed from the non driving end		Left hand side
d)	Rotation		90 Deg.
e)	Space heater		Motors rated 30KW and above shall have space heater suitable for 240V, 50 Hz single phase AC supply. Separate terminal box for space heaters & RTDs shall be provided.
f)	Cable glands and lugs		-Motor terminal box shall be furnished with Solder less crimping type heavy duty Lugs (aluminium lugs for aluminium cables and copper lugs for copper cables) and double compression Ni-Cr plated brass glands to match with cable used. -Gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
3.6	Earthing points suitable for conenction		Motor body shall be grounded at two earthing points on diagonally opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
3.7	Paint shade (Corrosion proof paints of colour shade)		RAL 5012 (Blue) The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However, in case electrostatic process of painting is offered. minimum paint thickness of 50 microns shall be acceptable for finish coat.Epoxy based paint with suitable additives shall be used.

3.8	The spacing between gland plate & centre of bottom terminal stud		UP to 3 KW As per manufacturer's practice. Above 3 KW - upto 7 KW 85 Above 7 KW - upto 13 KW 115 Above 13 KW - upto 24 KW 167 Above 24 KW - upto 37 KW 196 Above 37 KW - upto 55 KW 249 Above 55 KW - upto 90 KW 277 Above 90 KW - upto 125 KW 331 Above 125 KW-upto 200 KW 385/203 (For Single core cables only)
3.9	Minimum inter-phase and phase-earth air clearances with lugs installed		UP to 110 KW 10mm Above 110 KW and upto 150 KW 12.5mm Above 150 KW 19mm
4.0	**PERFORMANCE PARAMETERS**		
4.1	Starting requirement		
a)	Minimum permissible voltage as a percentage of rated voltage, at start to bring the driven equipment upto the driven equipment upto rated speed		a) Up to 85% of rated voltage for ratings below 110 KW b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW
b)	Maximum locked rotor current		as per IS 12615
c)	Starting duty		Two hot starts in succession, with motor initially at normal running temperature.
d)	The locked rotor withstand time under hot condition at highest voltage limit		a) atleast 2.5 secs. more than starting time(for motors with starting time upto 20 secs. at minimum permissible voltage during starting) b)atleast 5 secs. more than starting time(for motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting) c) more than starting time by at least 10% of the starting time(For motors with starting time more than 45 secs.at minimum permissible voltage during starting) Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
e)	The ratio of locked rotor KVA at rated voltage to rated KW		(a) Below 110KW : 10.0 (b) From 110 KW & upto 200 KW : 9.0
4.2	Torque (percent of full load torque)		1] Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. 2]Pull out torque at rated voltage shall not be less than 205% of full load torque.
4.3	Noise level (max.)		85 dB(A)
4.4	Vibration shall be limited within the limits		as per IS:12075
4.5	Temperature Rise		Air Cooled Motor (AC & DC) - 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation. Water Cooled - 80 deg. C over inlet cooling water temperature by resistance method for both thermal class 130(B) & 155(F) insulation.
5.0	**INSPECTION/TESTING**		
5.1	All type & Routine tests shall be as per IS 12615.		
5.2	The Contractor shall submit the type tests reports for the tests conducted on the equipment similar to those to be supplied under this contract and the test(s) should have been conducted at an independent laboratory not earlier than ten (10) years prior to supply under this contract.		

5.3	In case the contractor is not able to submit valid report of the type test(s) or in case type test report(s) are not found to be meeting the specification requirements, or not including all specified tests the contractor shall conduct all such tests under this contract. The cost of such test shall be deemed to be included in the price. The owner shall have right to witness the type tests.		
5.4	All routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.		
5.5	List of Tests for which reports have to be submitted for LT motors of above 100KW only. 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed. 3. Open circuit voltage ratio of wound rotor motors (in case of slip ring motors). 4. Full load test to determine efficiency power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test. 7. High Voltage Test. 8. Test for vibration severity of motor. 9. Test for noise levels of motor. 10. Test for degree of protection. 11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1.		
5.6	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design change" Minor changes if any shall be highlighted on the endorsement sheet.		

LOAD DATA FORMAT

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (dc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY	PEM (ELECTRICAL)
		PROJECT TITLE		NAME	DATA FILLED UP ON
		SYSTEM / S	PTP/DMP/ETP/STP/CWT/CLO2/ CHP Run off WTP/CPU/CDS/ODS	SIGN.	DATA ENTERED ON
		DEPTT. / SECTION		SHEET 1 OF 1 REV. 00	DE'S SIGN. & DATE

SECTION- IC

SPECIFIC TECHNICAL REQUIRMENT-CONTROL & INSTRUMENTATION

	SPECIFIC TECHNICAL REQUIREMENT
C&I TECHNICAL REQUIREMENT	
1	Control of auxiliary packages shall be as per Annexure-I.
2	Complete field instrumentation for monitoring and operation of auxiliary packages shall be provided by Vendor.
3	The quantity of instruments for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose.
4	Root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold, junction boxes and all other accessories required for erection of local / remote instruments shall be provided by Vendor. Double root valve to be provided where the design pressure is or more than 40kg/cm2.
5	The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes.
6	Bidder to provide Comprehensive Annual Maintenance Services (AMS) for three (03) years after warranty period for analysers and profibus instruments of mechanical auxiliary packages.
7	The Profibus protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/changes required based on DDCMIS system requirements and actual field installation,operational philosophy etc. shall be considered by bidder without any implications.
8	For all profibus devices GSD/DD and DTM files are to be provided for configuration/ testing in the DCS for proper interfacing and diagnostics.
9	Redundancy of sensors shall be provided by bidder (i) Triple redundancy for all analog and binary inputs required for protection of system/drives. (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.
10	For skid mounted instruments and instruments integral to equipments, process connection and piping can be in line with bidder's standard and proven practice.
11	Diaphragm seal shall be provided with Instruments having contact with corrosive media.
12	230 V AC UPS / 415V AC Power supply shall be provided by BHEL at a single point for each package/system, All necessary hardware for deriving other power supply from given feeder shall be in Vendor's scope. Bidder to furnish electrical load/UPS load data during detailed engineering.
13	All instruments other than profibus type shall be terminated on JB/LIE/LIR/LCP in field. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable. In case grouping is not possible and these are to be installed individually, canopy with suitable mounting arrangement shall be provided.
14	Temperature transmitter shall be provided for all temperature measurement applications (as applicable). All temperature transmitters shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas on as required basis. In case grouping is not possible and temperature transmitter is to be installed individually,TTJB, canopy with suitable mounting arrangement shall be provided.
15	In case of multiple measurements of temperature for any application, resulting in trip / protection, where logic implementation tolerates failure of one TE (e.g.2v3, 2v4 etc.), for only one of the TE, dual TT is to be provided.
16	Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply.

17	All transmitters and switches shall be suitably grouped together and mounted inside(i) Local Instruments Enclosures (LIE) in case of Open Areas of the Plant (ii) Local Instrument Racks (LIR) in case of covered areas (iii) Local Indicators/Gauges shall also be suitably grouped in Local Instrument Racks. In case grouping is not possible and these are to be installed individually, canopy with suitable mounting arrangement shall be provided.
18	All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipment are protected against rain/ sunlight etc.
19	All electric actuators, pneumatic control valves, Junction Boxes, Solenoid boxes and Local control panels which are not installed inside building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.
20	Number of pairs to be selected for Screen /Control cable 1. F-Type: 2P/4P/8P/12P (Size: 0.5sqmm) 2. G - Type: 2P/4P/8P/12P (Size: 0.5sqmm) 3. Control Cable: 3C/5C/12C (Size: 2.5sqmm)
	Applicable for ClO2 package
21	Bidder's presence is required for at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic in DCS. Bidder's presence is required in multiple visits at site during commissioning of DDCMIS for assistance related to process correctness. All the expenses like boarding, lodging and travel, air fare etc. shall be in bidder's scope.
22	All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.
23	For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.
24	All electrical devices like switches/ transmitters/ controller/ analyzer/ solenoid valves which are located in the in hazardous areas shall be made intrinsically safe by providing suitable type of transformer isolated barrier / Zener barrier of standard make & shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14 or shall comply with the essential requirements of ATEX directives.
25	For PT ClO2 System, Two (2) Nos. Online Residual Chlorine dioxide analyzer in the potable/raw water systems.1 No. handheld Calorimeter for on-spot measurement of residual ClO2. 2 Nos. ClO2 leak sensor with detector inside the room (common for PT & CW). Industrial type-high decibel hooter shall also be provided.
26	CW ClO2 System, 2 Nos. (one per unit) of Online Residual Chlorine dioxide analyzer in the Cooling Water Return Header. 1 No. portable ORP meter (common for CW & PT ClO2 systems).
	Applicable for DM plant system
27	All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.
28	Bidder's presence is required for at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic in DCS. Bidder's presence is required in multiple visits at site during commissioning of DDCMIS for assistance related to process correctness. All the expenses like boarding, lodging and travel, air fare etc. shall be in bidder's scope.

	Applicable for CPU package
29	All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.
30	Bidder's presence is required for at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic in DCS. Bidder's presence is required in multiple visits at site during commissioning of DDCMIS for assistance related to process correctness. All the expenses like boarding, lodging and travel, air fare etc. shall be in bidder's scope.
	Appplicable for PT Plant
31	All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.
	Applicable for CW Treatment package
32	All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.
33	For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.
34	All electrical devices like switches/ transmitters/ controller/ analyzer/ solenoid valves which are located in the in hazardous areas shall be made intrinsically safe by providing suitable type of transformer isolated barrier / Zener barrier of standard make & shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14 or shall comply with the essential requirements of ATEX directives.
35	Monitoring equipment like depositor monitor/fouling monitor (01), bio-fouling monitor (01), Corrosion test coupons with test racks (6 nos.), on-line instant corrosion rate monitor (01), online ORP monitor, analysis kits with reagents etc., online pH meter and conductivity meter etc. shall be provided.
	Applicable for ETP package
36	All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.
37	Bidder shall provide the Effluent quality monitoring system (EQMS) which include analysers (PH, Conductivity, COD/BOD, Oil in Water, TSS) as per specification.
38	**TYPE TEST GENERAL REQUIREMENT**
38.1	Submission of type test results and certificate shall be acceptable provided:
38.1.1	The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.
38.1.2	There has been no change in the components from the offered equipment & tested equipment.
38.1.3	The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.
38.2	In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.
38.3	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
38.4	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording, precautions to be taken etc. for the tests to be carried out.

39	**ANNUAL MAINTAINENCE SERVICE (AMS) FOR ANALYSERS**
39.1	SERVICES FOR ANALYSER INSTRUMENTS DURING DEFECT LIABILITY PERIOD
39.1.1	The Contractor shall provide an unlimited warranty on all equipments during the Defect liability period.This warranty shall include repair, replacement, replenishment of consumables (for e.g. reagents, calibration gases etc. as applicable) and correction of identified discrepancies including Analysers, Sample Handling System, Transmitters, (as applicable) etc. at no cost to Employer.
39.1.2	The Contractor shall provide warranty spares including components for each system based on (and keeping adequate over margin) normally experienced failure rate. Exhaustive list of all such items shall be submitted along with Datasheet for Employer's review and approval during details Engg stage regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Contractor along with the main equipment consignment. However, for items which have a limited shelf life shall be dispatched in a phased manner during the warranty period. Unused spares/consumables shall be Contractor's property after expiry of warranty period and shall be taken back.
39.2	SERVICES FOR ANALYSER INSTRUMENTS DURING ANNUAL MAINTENANCE SERVICE (AMS) PERIOD
39.2.1	The Contractor shall provide complete maintenance services for each System under comprehensive Annual Maintenance Service (AMS) for period of three years after the Warranty period.
39.2.2	The AMS shall cover total maintenance of all Analysers, Sample Handling System, Transmitters etc. coming under the scope of each system and shall include free repair/replacement of each items, replenishment of consumables, correction of problems (if any) and supply of expendable items.
39.2.3	Further, Contractor may note that during the AMS he will be allowed to use Employer's mandatory spares, but has to replenish the same within three months' time or before completion of AMS period whichever is earlier.
39.2.4	The Contractor shall prepare detailed list of faults corrected and parts, expendables utilized during AMS period and shall furnish the same to Employer, properly documented at the end of AMS period. Further, during AMS period the details as required by Employer/ Project Manager shall be made available by Contractor's personnel.
39.2.5	Contractor shall also provide a list of all required AMS spares which shall be finalized along with datasheet during detail Engineering stage. These spares will be dispatched by the Contractor at the beginning of AMS on yearly requirement basis. However, for items which have a limited shelf life shall be dispatched in a phased manner during the AMS period. Unused spare/consumable shall be Contractor's property after expiry of AMS period and shall be taken back.
39.3	DEPUTATION OF ENGINEER/ TECHNICAL EXPERT FOR ANALYSER INSTRUMENTS
39.3.1	Contractor shall depute Technical Experts of the OAM/OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month. Employer will intimate the contractor two weeks advance notice for start of deputation period.
39.3.2	After expiry of above six month period, Technical expert for each system shall visit site on monthly basis for monitoring the performance and rectify the problem (if any) for each system for the remaining warranty period and during entire AMS period. In the event of any malfunction/fault/failure in the system or any component thereof contractor shall depute Technical expert of respective system to reach site within 48hrs of call raised by site during the remaining warranty period and entire AMS period.
40	**ANNUAL MAINTAINENCE SERVICE (AMS) FOR PROFIBUS INSTRUMENTS**
40.1	The requirements specified below are applicable for warranty (defect liability period) and 3 years AMS period.
40.2	The Contractor's scope shall also include providing Post Warranty Maintenance for 3 years after completion of warranty period of the offered wireless systems and all associated components as per specification. The AMS shall include tools and tackle as required; travel, boarding & lodging of service engineer. In the event of any malfunction of the system hardware/system software, experienced service engineer shall be made available at site within 48 hours on the receipt of such information from Employer.

40.3	**The services under Post Warranty Maintenance Agreement, shall broadly comprise of the following:**
40.3.1	Periodic Maintenance Site visits, minimum four (4) times in a year (total days expected 16 in a year), schedule of visits to be discussed and finalized jointly between Contractor and client after placement of order/ delivery. It shall include inspection of general healthiness of the system, study and advice on daily maintenance, inspection of Hardware & Software, if any problem is reported, running of test programs, on-line servicing and solving reported problems. System shall be checked online.
40.3.2	Software Maintenance/ Support Contractor shall maintain the existing operating & application software for any debugging requirements to have consistent performance of the system.
40.3.3	Emergency Service In the event of any malfunction of the wireless system hardware/system software during this period, Service Engineer must report at site within 48 hrs. of report of failure. The system must be brought back within 48 hours after reporting at site.
40.3.4	Contractor shall note that while carrying out the Annual Maintenance Contract activities, Employer's engineers shall associate with the Contractor. On-job training of these associated engineers shall be covered under this scope. This shall include all items being supplied by Contractor, including any bought out items but not limited to the following: Labour, at no additional cost, to repair any system devices , to provide tests, and adjustment to system devices.
41	**REQUIREMENTS SPECIFIC TO VARIABLE FREQUENCY DRIVE (VFD)**
41.1	The VFD operation shall have no inherent detrimental impact on the Motors/ cables & supply system.
41.2	The panels shall be designed to provide easy access to hardware, to facilitate replacement of cards in case of any failure.
41.3	All the VFDs for particular application shall be of same design so as to ensure 100 % interchangeability of components.
41.4	Fiber optic cable connection shall be provided preferably to ensure high network reliability.
41.5	VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor. The vendor shall clearly state the limitations in the motor cable distance in his proposal. However, due to system requirements & constraints if the cable length becomes critical, filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics.

CONTROL SYSTEM FOR WATER TREATMENT PACKAGES

CONTROL SYSTEM FOR WATER TREATMENT PACKAGES (ANNEXURE-I)

Sl. No.	Package Name	Control from DCS	Local Control Panel (LCP)	Remarks
1	Effluent Treatment Plant (ETP)	Y	N	DCS in BHEL scope
2	DM Plant	Y	N	DCS in BHEL scope
3	PT Plant	Y	Y*	DCS in BHEL scope. *LCP, if applicable, shall be in bidder's scope
4	Sewage Treatment Plant (STP)	Y	N	DCS in BHEL scope
5	CW Treatment	Y	N	DCS in BHEL scope
6	ClO2 System	Y	N	DCS in BHEL scope
7	CHP Run off WTP	Y	Y*	DCS in BHEL scope. *LCP, if applicable, shall be in bidder's scope
8	Condensate Polishing Unit (CPU)	Y	N	DCS in BHEL scope
9	Chemical Dosing System	Y	Y	Start, stop operation & feedbacks through Local Control Panel. LCP in WTP bidder's scope.
10	Oxygen Dosing System	Y	N	DCS in BHEL scope
11	Lime Dosing System	Y	Y	Start, stop operation & feedbacks through Local Control Panel. LCP in WTP bidder's scope.

DATA SHEET FOR C&I ITEMS

TECHNICAL DATA - PART - A

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Impulse pipes, tubes (material, rating)		ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
1.2	Valves (material, pr. Class, size)		ASTM A182/ASTM A105 as per ASME 16.34
1.3	Fittings (size, rating, material)		ANSI B31.1, ANSI B31.1a, ASME B16.11
1.4	Installation schemes		BS 6739-2009, ANSI/ISA 77.70
1.5	Actuator		EN15714-2
1.6	Fieldbus concepts		IEC 61158
1.7	Instruments and apparatus for pressure measurement		ASME PTC19.2
1.8	Electonic transmitters		BS-6447, IEC-60770
1.9	Bourdon tube pressure and vacuum gauges		IS-3624
1.12	Code of practice for phosphating of iron and steel.		IS-6005
1.13	Colors for ready mixed paints and enamels.		IS-5
1.14	Direct Acting Indicating Analog Elec Measuring Instruments.		IS-1248
1.16	Circuit breaker for household and similar installations.		IS-8828
1.18	Annunciator Sequences and Specification		ISA-18.1
1.19	Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations		NFPA-496
1.21	Instrument and apparatus for temperature measurement		ASME PTC 19.3(1974)
1.22	Temperature measurement by electrical Resistance thermometers		IS:2806
1.23	RTD Sensor		IEC-751/ DIN-43760
1.24	Type of Enclosures		NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13)
1.25	Racks, panels and associated equipment		EIA : RS - 310 C- 1983 (ANSI C83.9 - 1972)
1.26	Protection class for enclosures, cabinets, control panels & desks		IS:2147 -1962
1.27	Standard for Silt Density Index (SDI) Analyser		ASTM D4189-07
1.28	**Codes for Orifice plate Design**		
	Orifice plate		ISO 5167
	Flange Standard for Orifice plate		ASME B16.36
1.29	**Codes for Control Valve Design**		
	Control Valve Sizing		ISA S-75
	Pressure / Temperature Rating		ANSI-B16.34
	Seat Leakage		ANSI/FCI 70.2
	Noise		IEC 60534-4
	Face to face dimensions of control valves		ANSI B 16.00
	End Connection: Butt Weld		ANSI B16.25
	End Connection: Socket Weld		ANSI B16.11
	End Connection: Flanged End		ANSI B16.5
	End To End Tolerance		ANSI B16.10
	ISA Hand Book of Control Valves		(ISBN : B: 1047-087664-234-2)

	Codes for pressure piping		ANSI B 31.1
	Control Valve leak class		ISA RP 39.6
1.30	**Codes for VFD Design**		
	DC reactor		IEC:60289
	Bushing		IS: 2099, IEC 60137
	Adjustable Speed Electrical Power Drive Systems		IEC 61800
	Semiconductor converters–General requirements		IEC 60146
	IEEE Recommended practices and requirements for harmonic control in electrical power systems		IEEE 519
	Degrees of protection provided by enclosures (IP Code)		IEC 60529
	Electrostatic immunity test		IEC1000-4-2
	Fast transient immunity test		IEC1000-4-4
	Surge immunity test		IEC1000-4-5
	AC electricity meters		IS: 722
	Metal oxide surge arrestor without gap for AC system		IEC: 60099-4
	Terminal blocks for copper conductors		IEC: 60947-7-1
	Motor		IS:15999, IEC-60034, IEC60034 / NEMA 30 & 31
	Contactor/Switches/Fuses etc.		IEC:60947, IS: 13947
	Harmonics & EM compatibility		IEEE:519/IEC: 61000
	VFD		IEC: 60034/ IEC: 61800
2.0	**DESIGN /SYSTEM PARAMETERS**		
	ELECTRONIC TRANSMITTERS		
2.1	**DATASHEET - PRESSURE TRANSMITTER, DIFFERENTIAL PRESSURE TRANSMITTER, DP BASED FLOW AND LEVEL TRANSMITTER**		
	Output		Profibus PA complying to IEC 61158, digital output
	Turndown ratio		50:1
	Accuracy	%	0.06%
	Stability (% of calibrated range)	%	+/-0.25% for 10 year
	Diaphragm seal material		Suitable for process fluid
	Diagram fill fluid		Inert liquid
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for chemical application
	Housing		Metallic housing with durable corrosion resistant coating
	Protection		Weather proof IP-67
	Display		Integral digital display
	Diagonstic feature		Required
	Electrical connection		1/2" NPT (F)
	Manifold		2/3 valve non integral manifold for PT and 5 valve non integral manifold for DPT
2.2	**DATASHEET - GUIDED WAVE (GW) RADAR TYPE LEVEL TRANSMITTER**		
	Transmitter Type		Microprocessor based 2 wired HART type GW Radar
	Principle		TDR (Time Domain reflectometry)
	Output		4-20 mA DC alongwith superimposed digital signal, suitable for overfill prevention
	Probe Type & Material		Rod / Co-axial Probe of SS316/SS316L suitable for process application

	Accuracy		±0.5 of calibrated span or minimum 5mm
	Housing Material		Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
	PowerSupply		24 VDC +/- 10%
	Display		Integral digital display
	Electromagnetic Compatibility		shall meet EN 61326-1(1997) and AmdtA1, class A equipment/EN50081-2 & EN 5008 1-2 & EN 50082-2
	Electrical Connection		Plug and socket
	Conduit/CableThread		1/2" NPT(F)
	Zero & Span adjustment		Continuous Temper proof, remote as well as manual adjustability from instrument, It should be possible to calibrate the instrument without any level in the tank/sump etc.
	Load Impedance		500 ohms (minimum)
	Mounting		Side mounted (with external cage) / top mounted
	Mounting accessories		Required
	All weather canopy		Required for protection from direct sunlight and direct rain for open locations.
2.3	**DATASHEET - ULTRASONIC LEVEL TRANSMITTER**		
	Transmitter type		Non contact microprocessor based 2 wire type loop powered, HART protocol compatible
	Output signal	mA	4-20 mA DC (analog signal) alongwith superimposed digital signal based on HART protocol
	Accuracy	%	±0.5% of calibrated span or minimum 5mm
	Power supply	V	24V DC +/- 10%
	Temperature compensation		To be provided within transducer
	Housing material		Metallic housing with durable corrosion resistance coating
	Protection		Weather proof as per IP-65
	Sensor material		Corrosion resistant material to suit individual application requirement
	False signal tolerance		Transmitter shall be capable of ignoring false echoes from internal tank/sumped obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
	Display		Integral digital display
	Diagnostics		Loss of echo alarm etc.
	Electrical connection		Plug and socket
2.4	**DATASHEET - TEMPERATURE TRANSMITTER**		
	Transmitter Type		Profibus PA complying to IEC 61158 with EMC compatibility as per EN 61326, Dual input (Trip/Protection), Single Input (other application)
	Compatibility		fully compatible with RTDs
	Protection Class		IP-67
	Display		Integral digital display
	Diagonstic feature		self-indicating diagnostics
	Operating ambient temperature (with display)	DegC	70 deg C
	Operating ambient temperature (without display)	DegC	85 deg C
	Electrical Connection	inch	1/2” NPT(F)

	Composite Accuracy	%	RTD =<0.25% of 0-250 deg C span
	Changeover facility		Bump less changeover to second sensor in case first sensor fails with alarm facility.
	Composite accuracy Calculation		Accuracies of temperature transmitter for converting sensor input to output + temperature effect on these accuracies at ambient temperature of 50 deg C (based on the figure/ formula given in the standard product catalogue for span as specified for RTD).
	Emergency/failure Measures		In case of failure (open or burn-out) of RTD, transmitter shall provide low temperature output.
	RTD & THERMOWELL		
2.5	**DATASHEET - RESISTANCE TEMPERATURE DETECTOR (RTD)**		
	Type		Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
	No. of element		Duplex
	Housing		Diecast Aluminium
	Protection Class		IP-65
	Head		Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter
	Plug in connectors		Required
	Terminal head		Spring loaded for positive contacts with the thermo well
	Insulation and sheathing		Mineral (magnesium oxide) insulation and SS316 sheath
	Calibration and accuracy		As per IEC-751/ DIN-43760 Class-A for RTD
	Accessories		Thermo well and associated fittings
2.6	**DATASHEET - THERMOWELL**		
	Design		One piece solid bored type of step-less tapered design
	Material		SS316
	LOCAL INSTRUMENTS / GAUGES		
2.7	**DATASHEET - PRESSURE GAUGE, DIFFERENTIAL PRESSURE GAUGE**		
	Sensing element		Bourdon for high pressure, diaphragm/bellow for low pressure
	Sensing element material		SS316
	Movement material		SS316
	Body material		SS316
	Dial size	mm	150mm
	End connection	inch	1/2 inch NPT (m)
	Accuracy		±1% of span
	Scale		Linear, 270° arc graduated in metric units
	Range selection	%	Cover 125% of max. of scale
	Over range Test pressure		Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.
	Diaphragm seal material		Suitable for process fluid
	Diaphragm fill fluid		Inert liquid
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for process application
	Housing		IP-55

	Zero/span adjustment		External
	Identification		Engraved with service legend or laminated phenolic nameplate
	Accessories		Blow out disc, siphon, snubber, pulsation, dampener, chemical seal, gauge isolation valve
2.8	**DATASHEET - LEVEL GAUGE**		
	Sensing element and material		Tempered toughened borosilicate gauge glass steel armoured reflex or transparent type, bicolour type
	Body material		Forged carbon steel/304 SS
	End connection		Process connection as per ASME PTC , 3/4" and drain/vent 15 NB
	Scale		Linear Vertical
	Accuracy	%	± 2%
	Range selection		Cover 125% of max. of scale
	Over range Test pressure		Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.
	Housing		CS/304 SS leak proof
	Identification		Engraved with service legend or laminated phenolic nameplate
	Accessories		Gasket for all KEL-F shield for transparent type vent and drain valves of steel/SS as per CS /Alloy process requirement.
	Length of Gauge glass		Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.
2.9	**DATASHEET - TEMPERATURE GAUGE**		
	Body Material		Die-cast aluminium
	End connection		3/4" NPT (M)
	Accuracy	%	± 1% of span
	Dial Size	mm	150 mm
	Scale		Linear, 270° arc graduated in °C
	Range selection	%	Cover 125% of max. of scale
	Over range test		Test pr. for the assembly shall be 1.5 to the max. Design pr. At 38°C.
	Housing		IP-55
	Zero/span adjustment		Required
	Accessories		SS Thermowell
	PROCESS ACTUATED SWITCHES		
2.10	**DATASHEET - LEVEL SWITCH**		
	Sensing Element		Float type, conductivity type, Ultrasonic type as per suitability to the application
	Material		316 SS
	End connection		Manufacturer standard
	Over range/ proof pressure	%	150% of maximum operating pr.
	Accessories		All mounting accessories
	Repeatability	%	+/-0.5% of full range
	No. of contacts		2 No.+2NC. SPDT snap action dry contact
	Rating of contacts	V, VA	60 V DC, 6 VA
	Elect. Connection		Plug in socket.
	Set point adjustment		Provided over full range.

	Dead band adjustment		Adjustable/ fixed as per requirement of application.
	Enclosure		IP-55
	Power Supply	V	24V DC
2.11	**DATASHEET - PRESSURE / DRAFT SWITCHES / DP SWITCHES**		
	Sensing Element		Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum as per suitability to the application.
	Material		316 SS
	End connection		½ inch NPT (F)
	Over range/ proof pressure		150% of maximum operating pr.
	Accessories		Siphon, snubber, chemical seal, pulsation dampeners as required by process
	Mounting		Suitable for enclosure/ rack mounting or direct mounting
	Repeatability		+/-0.5% of full range
	No. of contacts		2 No.+2NC. SPDT snap action dry contact
	Rating of contacts		60 V DC, 6 VA
	Elect. Connection		Plug in socket.
	Set point adjustment		Provided over full range.
	Dead band adjustment		Adjustable/ fixed as per requirement of application.
	Enclosure		IP-55
	Power Supply		24V DC
2.12	**COMMON REQUIREMENTS FOR PROCESS ACTUATED SWITCH**		
	Repeatability	%	+/-0.5% of full range
	No. of contacts		2 No.+2NC. SPDT snap action dry contact
	Rating of contacts		60 V DC, 6 VA
	Elect. Connection		Plug in socket.
	Set point adjustment		Provided over full range.
	Dead band adjustment		Adjustable/ fixed as per requirement of application.
	Enclosure		IP-55
	Power Supply	V	24V DC
	FLOW ELEMENTS & FLOW METERS		
2.13	**DATASHEET - ORIFICE PLATE**		
	Material		SS316
	Thickness	mm	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.
	Tappings		Flanged weld neck or D & D/2
	Number of tappings	pair	3 pairs, However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
	Beta Ratio		0.34 to 0.7
	Root Valves		To be provided in all the tappings
2.14	**DATASHEET - ROTAMETER**		
	Type		Variable area metal tube
	Fluid Media		Water / Oil
	Tube Media		SS316
	Material of Float		SS316
	Indicator		Linear scale
	Accessories		Flange, Orifice in case of bypass Rotameter (for line size above 100 mm}
	Housing protection class		IP-55

	Accuracy	%	± 2% of measured value
2.15	**DATASHEET - ELECTROMAGNETIC FLOW METER**		
	Type		Flow sensor and flow indicator cum integrator / totaliser
	Measuring principle		Full bore electromagnetic principle
	Output	mA	4-20 mA DC Isolated output
	Accuracy		± 0.5% of calibrated span or better
	Repeatability		± 0.2% of calibrated span or better
	Power Supply		240V AC ± 10%, 50 HZ ± 5%/ 24 V DC
	Protection class		IP-55
	Flow tube		SS304
	Liner		Hard Rubber
	Local indication		Required
	ANALYSERS		
2.16	**DATASHEET - PH ANALYSER**		
	Type		Cell flow through sample
	Measuring Range	pH	0-14 units of pH
	Temperature Compensation		Automatic
	Accuracy	%	<= +/-1 %
	Output signals	mA	Analog 4-20 mA DC galvanically isolated
	Zero & span Adjustment		To be provided with range selection facility
	Ambient Temp	DegC	50 degC
	Sample Temperature	DegC	40 degC
	Indication		Digital Alphanumeric Display of reading in engineering units
	Type of Electronics		Microprocessor based with self-diagnostic
	Tubing and cabling		Required between sensor and analyzer / analyzer panel etc.
	Enclosure		IP66
	Accessories		Required for mounting the sensor/analyser
	Digital Signal Transmission		Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer ' s central cloud server in addition to 4-20mA connectivity to DDCMIS.
	Compliance to standards		Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.
	Power	V	230V AC
2.17	**DATASHEET - CONDUCTIVITY ANALYSER**		
	Type		Continuous flow through type
	Measuring Range	µS/cm	0 – 60000 µS/cm for sea water application 0-5000 µS/cm for other application
	Response Time	second	<= 5 sec (90% of full scale)
	Temperature Compensation		Automatic
	Power	V	230V AC
	Accuracy	%	<= +/-1 %
	Output signals		Analog 4-20 mA DC galvanically isolated
	Zero & span Adjustment		To be provided with range selection facility

	Ambient Temp	DegC	50 degC
	Sample Temperature	DegC	40 degC
	Indication		Digital Alphanumeric Display of reading in engineering units
	Type of Electronics		Microprocessor based with self-diagnostic
	Tubing and cabling		All interconnection between sensor and analyzer / analyzer panel etc to be provided
	Accessories		Required for mounting the sensor/analyser
	Digital Signal Transmission		Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer ' s central cloud server in addition to 4-20mA connectivity to DDCMIS.
	Compliance to standards		Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.
2.18	**DATASHEET - CHEMICAL OXYGEN DEMAND (COD)/ BIOLOGICAL OXYGEN DEMAND (BOD) ANALYSER**		
	Output signals	mA	Analog 4-20 mA DC galvanically isolated
	Principle (COD/BOD measurement)		Option A. Total Organic Carbon (TOC) measurement complying to US EPA 415.1 / 415.2 or equivalent standard for effluent/sewage/waste water.
			Option B. UV-VIS spectrometer measuring absorption in UV-VIS spectrum.
	Measuring Range	mg/L	0-50 mg/L for BOD, 0-500 mg/L for COD
	Response Time	min	<= 15 min
	Power	V	230V AC
	Cleaning		Self-cleaning (Automatic)
	Accuracy	%	+/- 3%
	Zero & span Adjustment		To be provided with range selection facility
	Ambient Temp	DegC	50 degC
	Sample Temperature	DegC	40 degC
	Indication		Digital Alphanumeric Display of reading in engineering units
	Type of Electronics		Microprocessor based with self-diagnostic
	Tubing and cabling		All interconnection between sensor and analyzer / analyzer panel etc to be provided
	Accessories		Required for mounting the sensor/analyser
	Digital Signal Transmission		Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer ' s central cloud server in addition to 4-20mA connectivity to DDCMIS.
	Compliance to standards		Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.
2.19	**DATASHEET - OIL IN WATER ANALYSER**		
	Output signals	mA	Analog 4-20 mA DC galvanically isolated
	Principle		UV Fluorescence
	Measuring Range	mg/l	0 to 30 mg/l
	Response Time	second	<= 60 sec
	Power		230V AC
	Cleaning		Self-cleaning (Automatic)
	Accuracy	%	+/- 5 % of full scale
	Zero & span Adjustment		To be provided with range selection facility

	Ambient Temp	DegC	50 degC
	Sample Temperature	DegC	40 degC
	Indication		Digital Alphanumeric Display of reading in engineering units
	Type of Electronics		Microprocessor based with self-diagnostic
	Tubing and cabling		All interconnection between sensor and analyzer / analyzer panel etc to be provided
	Accessories		Required for mounting the sensor/analyser
	Digital Signal Transmission		Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer ' s central cloud server in addition to 4-20mA connectivity to DDCMIS.
	Compliance to standards		Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.
2.20	**DATASHEET - TOTAL SUSPENDED SOLIDS (TSS) ANALYSER**		
	Output signals	mA	Analog 4-20 mA DC galvanically isolated
	Principle		Light reflection principle
	Measuring Range	mg/l	0-500 mg/l
	Response Time	minute	<= 5 min
	Power	V	230V AC
	Cleaning		Self-cleaning (Automatic)
	Accuracy	%	+/- 5%
	Zero & span Adjustment		To be provided with range selection facility
	Ambient Temp	DegC	50 degC
	Sample Temperature	DegC	40 degC
	Indication		Digital Alphanumeric Display of reading in engineering units
	Type of Electronics		Microprocessor based with self-diagnostic
	Tubing and cabling		All interconnection between sensor and analyzer / analyzer panel etc to be provided
	Accessories		Required for mounting the sensor/analyser
	Digital Signal Transmission		Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer ' s central cloud server in addition to 4-20mA connectivity to DDCMIS.
	Compliance to standards		Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.
2.21	**DATASHEET - SODIUM ANALYSER**		
	Type		Continuous flow through sample
	Range		0-1,0-10,0-100 ppb freely programmable
	Response Time	minute	≤ 4 min
	Stability		Calibration once in a month
	Power	V	230V AC
	Accuracy	%	≤ ± 10% of reading
	No. of streams		Multi stream with sequencer/stream selector (min.4 streams)
	Material of flow cell		SS316
2.22	**DATASHEET - SILICA ANALYSER**		
	Type		Continuous Colorimetric Type
	Accuracy	%	≤ ± 5% of reading

	Response Time (90 % of Full Scale)	minute	≤ 15 min. (including sample switching)
	Range	ppb	0-50, 0-100 ,0-500 ppb freely programma ble
	Power	V	230V AC
2.23	**DATASHEET - ONLINE ORP MONITOR / ANALYSER**		
2.23.1	**ORP Sensor**		
	Type		Cell -flow through
	Accuracy	mv	< ± 1mv
	Range	mv	-1400mv to +1400mv
	Electrode		Platinum
2.23.2	**Monitor / Analyzer Specification**		
	Type of electronics		Microprocessor based
	Zero & span Adjustment		To be provided
	Ambient temp.	DegC	50 DegC
	Display		LCD
	Enclosure Type / Material		Weather and Dust proof (IP 65)
	Output signals Analog	mA	4-20 mA DC
	Error / fault Diagnostic		To be provided.
	Power supply	V	230V AC
	Load	Ohms	500 Ohms minimum
	Mounting		All weather Local Panel fitted with integral Air Conditioner are to be provided by the Contractor
2.24	**DATASHEET - PARSHALL FLUME**		
	Primary Sensors		Required
	Transmitters		Required
	Flow indicator cum integrator / totaliser		Required
	Accessories		Required
	Level measurement		Ultrasonic/Radon technology
	Flow compensation		In Transmitter itself
	Output		4-20mA DC
	Load impedance		500 ohms
	Accuracy		+/-1% or better
	Mounting hardware and accessories for erection and commissioning		Required
	Mounting fittings material		SS316
	All weather canopy		To be provided for electronics/sensor to protect the same from rain/sunlight etc.
	Type makes and models no.		Subject to Owner's approval
2.25	**DATASHEET - CHLORINE ANALYSER**		
	Accuracy	%	± 5 % or ±0.03 mg/L (ppm) as CL2, whichever is greater
	Cycle Time		2.5 minutes
	Power Supply	V	230V AC
	Display		LCD
	Enclosure Construction		IP62
	Accessories		Mounting Bracket (CS/ MS) U bolts, nuts, screws, Washers
2.26	**DATASHEET - TURBIDITY ANALYSER**		
	Type		Light reflection principle
	Accuracy	%	≤ 2% for range 0-50 NTU, ≤ 5% for range 50 – 200 NTU
	Range	MTU	0 – 100, 0- 200 MTU, programmable

	Response Time (90 % of Full Scale)	min	≤ 5 min.
2.27	**DATASHEET - SILT DENSITY INDEX (SDI) ANALYSER**		
	Power supply		230V AC
	Output		4-20mA
2.28	**DATASHEET - BIO FOULING MONITOR**		
1	Standard		As per NACE standard RP0189-2002
2	Type		Online, Loss In static pressure due to friction in the direction of flow
3	Cooling water Sample Bypass tube/pipe for DP measurement		Stainless Steel
	Measurement		Differential pressure
4	Accessories:-		Qty
	(i) Flow Meter		1 Nos
	(ii) Manual Flow Control valve		2 Nos
	(iii) Differential pressure transmitter (Across the tube)		1 Nos
	(iv) Pressure gauge (At Inlet)		1 Nos
	(v) Strainer (To Eliminate suspended solids) Eliminate suspended solids		
2.29	**DATASHEET - CORROSION METER**		
1	Type of electronics		Microprocessor based
2	Zero & span Adjustment		Required
3	Ambient temp.		50 DegC
4	Display		LCD
5	Range		
	Corrosion rate		0.01 to 150 MPY
	Imbalance (Pitting Index)		0.01 to 100 pitting units
6	Accuracy		< ± 2% of reading
7	Enclosure Type / Material		Weather and Dust proof (IP 65)
8	Mounting		All weather Local Panel fitted with integral Air Conditioner are to be provided by the Contractor
	Sensor Probe Specification Requirement		
a)	Type		Linear Polarization Resistance Probe (LPR)
b)	Electrodes		2 electrode/3 electrode
c)	Spares		Three sets of spare electrodes for LPR probes
2.30	**DATASHEET - DEPOSIT MONITOR**		
1	Standard		As per NACE standard RP0189-2002
2	Type		Online, Annular flow, scale deposition
3	Measurement		Deposit weight and average weight per unit surface area
4	Observation		Online-Visual, Offline-Quantitative by weighing heat transfer surface
5	**Accessories:-**		**Qty**
	Flow Switch		1 Nos
	Flow meter (Rota meter)		1 Nos
	Manual Flow Control valve		1 Nos
	Skin temperature Sensor		2 Nos
	Temperature Controller		1 Nos
	Digital Temperature Indicator		2 channel
	Electric heater(Electrical resistance heating element)		2 Nos
6	Power Supply		230V AC
7	Electric heater protection		(a). No water Flow
			(b).Outlet temperature more than set point
2.31	**DATASHEET - CIO2 LEAK DETECTOR**		

	Type		Microprosser Based
	Material		Sensor : SS 316 with PTFE filter
			Trasmitter : Epoxy Painted Aluminiumalloy LM25
	Measuring Range		0 -1 ppm as CL02
	Output Signal		4-20 mA
	Max.Over Range		22 mA
	Enclosure		IP66
	Display		LCD
	Self Diagnostic		Required
	Cable entry		2 X M20
	Signal termination Type		Screw Terminal
	Power supply		2 wire Loop Power (24 V DC)
2.32	**DATASHEET - CIO2 ANALYSER**		
	Measurment Type		Amperometric/Membrane (electrode, membrane, electrolyte)
	Material		Probe body PVC
	Output Signal		4-20 mA HART Compatible
	Sensor		
	Accuracy		5%
	Response time		90 sec
	Measurement Interval		Continuous
	Min. Detection Limit		0.01 mg/l Clo2
	Transmitter		
	Housing Type		Aluminium (Powerdercoated)
	Calibration Range		0 to 2 ppm
	Accuracy		0.5% of FS
	Power supply		230 V AC (4 wire transmitter)
	Enclosure		IP66
	Display		LCD
	Cable entry connection		1/2" NPT
	Sampling System		
	Min. Flow rate		14 lit/hrApprox
	Utilities requirment		Water Sampling Connection
	Sample Connection		1/4"
	Sample Return To		Drain
	Sample Return Pressure		Atm
	Utility Connection		1/2" NPT
2.33	**ENCLOSURE/CABINETS / PANELS FOR EQMS AND ANALYSERS OF PT, ETP, CHLORINATION, DM/RO, CWT AND CPU PLANT**		
	Sheet Material of enclosure/cabinet/panel	mm	Steel plate (SS304) with minimum 2 mm thick
	Frame material & thickness	mm	3 mm thick channel frame of SS304
	Protection Class		IP-65 or better
	Lighting provision		Required
	Design		Separate wet and dry section, exact details shall be finalized during detailed engineering
	Type		Free Standing Type

	Canopy		Minimum 3 mm thick steel, and extended beyond the ends of the rack.
	CONTROL VALVE, MOTORISED VALVE ACTUATOR, SOLENOID VALVE, LIMIT SWITCHES, VARIABLE FREQUENCY DRIVE, LOCAL CONTROL PANEL		
2.34	**DATASHEET - CONTROL VALVE**		
	The Control valve, Actuator and the accessories operating conditions		Continuous operation under an ambient temperature : 0-60°C, Relative Humidity : 0-95%.
2.34.1	**Valve Selection Criteria**		
	Valve Opening at maximum flow conditions		not greater than 80% of total Valve stem travel
	Valve Opening at minimum flow conditions		not less than 10% of total Valve stem travel
	Stem travel range from minimum flow to maximum flow		not less than 50% of total Valve stem travel
	Flow capability		at least 120% of maximum flow
	Trim requirement for cavitation / flashing service		Anticavitation Trim/ Hardened Trim
	Bonnet joints type		Flanged and Bolted type
	Body Material		Carbon steel ASTM-A216 Gr. WCB
	Trim material		316SS stellited with stellited faced guide posts and bushings.
	Plug Type		Plug shall be of one-piece construction cast, forged or machined from solid bar stock, BALANCED type
	Plug connection with stem		Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.
	Control Valve Guide type		High lift cage guided plugs
	Trim type		Quick-change
	Noise limitation		noise shall be limited to 85 dBA at 1 meter from valve surafce under actual operating condition.
	Noise abatement method		The noise abatement shall be achieved by valve body and trim design and not by use of silencers
	Flow action for vacuum application		Above the Seat
	End connection		Butt weld end (BWE)
	Leakage class		Class IV
	Packing material / Number / Type		Grafoil / Single / Standard
	Valve outlet velocity		< 7 m/sec (WATER)
	Valve actuators		Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating.
	Travel time		less than 10 seconds.
	Control Valve accessory devices		Air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc.
2.21.2	**Specifications for Microprocessor based Electronic Positioner**		
	Type		Pneumatic with smart positioner (profibus)
	Protection class.		IP-65 Minimum
	EMC & CE Compliance		EN50081-2 & EN50082 or equivalent.

	Smart positioner & position limit switch		Required
	Position transmitter & E/P converter		Part of smart positioner
	Air filter regulator & air lock relay		Required
	Junction box		Required
	Hand wheel (side mounted) & local positioner indicator		Required
2.34.3	**Accessories**		
	In-built Operator Panel		Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
2.35	**DATASHEET - MOTORISED VALVE ACTUATOR**		
2.35.1	**General**		
	Duty		☐ On / Off ☐ Inching
	Valve type		☐ Globe ☐ Gate ☐ Reg. Globe ☐ Butterfly
	Ambient condition		Shall be suitable for continuous operation under an ambient temp. Of 0-60 deg c and relative humidity of 0-95%
2.35.2	**Construction and sizing**		
	Construction		Totally enclosed weather proof, minimum IP:68
	Mechanical position indicator		To be provided for 0-100% travel
	Bearings		Double shielded, grease lubricated anti-friction.
	Gear train for limit switch/torque switch operation		Metal (not fibre gears). Self-locking to prevent drift under torque switch spring pressure when motor is de-energized.
	Sizing		Open/close at rated speed against designed differential pressure at 90% of rated voltage. For isolating service three successive open-close operations or 15 mins. Whichever is higher. **For inching service - 150 starts/hr or required cycles whichever is higher.**
2.35.3	**Handwheel**		
	Required		■ Yes ☐ No
	Orientation		☐ Top Mounted ☐ Side Mounted
	Additional requirement		To disengage automatically during motor operation.
2.35.4	**Electric actuator**		
	Motor type		Squirrel cage induction motor suitable for Direct On-Line (DOL) Starting
	Power supply to motor / starter		415V +/- 10%, 3 Ph, 3W & 50Hz +/- 5%
	Control voltage requirement		To be derived from the Power Supply to the Starter ☐ 230 V ■ 110 V AC / 24 V DC
	Enclosure class of motor		IP 68
	Insulation class		Class F. Temperature Rise 70 Deg C. Over 50 Deg C Ambient
	Winding temp protection		Thermostat (3 Nos.,1 In Each Phase)
	Single phasing protection & wrong phase sequence protection		Required, suitable means shall be provided to diagnose the type of fault locally.
2.35.5	**Integral starter**		
	Integral starter		Required with built in SPP (Single Phasing Preventer)
	Type of switching device		■ Contactors ☐ Thyristors
	Type		Non-Intrusive Profibus Actuator
	Feature		All actuator settings including torque, limit shall be possible without opening the actuator cover.
	If smart		
	A) Serial link protocol		☐ Foundation Field-Bus ■ Profibus DP
	B) Redunadant profibus DP port		Required
	C) Hand held programmer		Not Required
	D) Profibus DP cable connection		Suitable connector integral to the actuator, or external devices/ accessories (mounted inside minimum IP65 protection class enclosure) shall be provided so that the actuator can be isolated online from the profibus network without disturbing the profibus communication of other actuators of the segment.

	E) Open/Close command termination logic		Shall be suitably built inside actuator
	F) GSD and DTM files		To be provided which shall be configured/ tested with DCS for proper interfacing and diagnostics
	G) Available signals to DCS (through profibus network)		Open/ close commands, open/ close feedback status, disturbance signal etc. along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DCS
	Step down cont. Transformer		Required
	Open / close PB		Required
	Stop PB		Required
	Indicating lamps		Required
	Local remote s/s		Required (Lockable)
	Status contacts for monitoring		Required
2.35.6	**Position/ torque transmitter**		
	Position/torque transmitter		i. Position/limit measurement shall be done using absolute encoders which will give information of position/limit in both the directions.
			ii. Electronic measurement of torque shall be provided.
	Supply		24V DC
	Accuracy		+ 1% FS
2.35.7	**Space heater**		
	Space heater		Required
	Power supply (non integral)		230V AC,1 Ph.,50 Hz
	Power supply (integral)		Power supply derived from main power supply available at actuator end
2.35.8	**Terminal block**		
	Actuator/motor terminal block		Required. For power cables, the grade of TBs shall be minimum 650V
	Terminals / connectors		Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided
	Earthing terminal		Required (2nos.)
2.35.9	**Cable glands**		
	Type		Double Compression
	Material		Brass Material
	Armored fieldbus cable glands		Required
	Power cable glands		Required
2.35.10	**Wiring**		Suitable voltage grade copper wire
2.35.11	**LCD Display**		
	LCD Indication		Integral to actuator body
	Local display information		Regarding actuator alarms, status and valve position indications as a minimum.
2.35.12	**Motor considerations**		
	Power Supply		shall operate satisfactorily under the +/- 10% supply voltage variation at rated frequency, -6% to +4% variation in frequency at rated supply voltage, simultaneous variation in voltage & frequency the sum of absolute percentage not exceeding 10%.
2.35.13	**SIL certification**		SIL2
2.35.14	**Accessories**		
	Accessories for calibration / settings / configuration of various parameters of actuator		Required
2.36	**DATASHEET - MODULATING DUTY ELECTRIC ACTUATOR**		
	Duty		Continuous duty / Modulation
	Operating Ambient Temperature		-20 to +60 Deg C or better
	Enclosure Protection		IP 68
	Resolution/ Precision		0.1%- 0.2% or better of total travel
	Supply Voltage frequency		415V +/- 10%, 3 Phase, 50HZ +/-5% or 230V +/- 10%, Single Phase, 50Hz +/- 5%
	Motor Suitable for		Continuous Duty
	Motor insulation Class		F
	Analog Control		4-20mA, (24VDC)

	Position Transmitter		4-20mA (24VDC)
	Integral Starter		Yes
	Terminal Block		For power cables, the grade of TBs shall be minimum 600V
	Accessories (if applicable)		for calibration / settings/ configuration of various parameters of actuator shall be provided
	Hand wheel		Yes
	Standard Compliance		EN 15714-2 Class D or equivalent
2.37	**DATASHEET - SOLENOID VALVE**		
	Type		2/3/4 way SS 316/Forged Brass (depending on the application subject to Customer's approval during detailed Engg.)
	Power supply		24 V DC + 10%.
	Electrical connection		Plug and socket
	Insulation		Class 'H'
	IP Class		IP65
	Limit switches (for open/close feedback)		Required
2.38	**DATASHEET - LIMIT SWITCH (for other packages)**		
	Corrosion resistance		Silver plated with high conductivity and non corrosive
	Protection class		IP 55
	Contact rating		shall be sufficient to meet the requirement of DCS subject to a minimum of 60 V, 6 VA rating
2.39	**DATASHEET - LIMIT SWITCH (for PT, DM, Chlorination system , Chemical treatment, ETP)**		
	Type		Inductive proximity type
	Mounting arrangement		Inside the enclosure
	Operating voltage Range	V	10-40 V DC
	Sensing system		Inductive Proximity type , 2 Wire
	Sensor Contact Type		NO
	Reverse polarity and short circuit protection		Yes
	IP Class-Sensor		IP67
	IP Class-Enclosure(Switch box)		IP67
	Cable entry-Enclosure(Switch box)		2 no-1/2" NPT
	Casing material-Sensor		Brass /SS
	Enclosure(Switch box) Housing material		FRP or SS
	Operating Ambient temp(sensors)	DegC	-5 to 70 deg C
	Max allowed Voltage Drop across sensor	V	5 V
	Standard applicable		EN 60947-5-2 or equivalent.
	Applicable for		Manual valves and solenoid operated on-off valves
2.40	**DATASHEET - MASS FLOW CONTROLLER (Applicable for Oxygen Dosing System)**		
	Type		Thermal Mass Flow controller
	Output Signal		4-20 mA along with HART compatible
	Power supply		24 V DC
	Fluid Handled		Oxygen gas
	MOC		SS316
	Response Time		Less than 1 Sec
	Turn Down Ratio		50 : 1
	Accuracy		+/- 1%
	End Connection		1/2" tube compression fitting with filter

	Protection class		IP 65
2.41	**LOCAL INSTRUMENT ENCLOSURE AND LOCAL INSTRUMENT RACK**		
	Scope		LIE and LIR complete with all fittings, mountings & accessories, drains and utility lighting, cable & grounding cable etc.
	Construction		
	Rack	mm	1.6mm sheet plate
	Frame	mm	3mm thick channel frame of steel
	Free standing type		Yes
	Canopy		Yes, >=3mm thick steel, extended beyond the ends of the rack.
	Degree of Protection		IP-55 for LIE & JB of LIE/LIR
	Junction Box		Applicable
2.42	**JUNCTION BOX**		
	No. of ways		12/24/36/48/64/72/96/128
	Material and Thickness		4mm thick Fiberglass Reinforced Polyester(FRP)
	Type of terminal blocks		Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm2. A M6 earthing stud shall be provided.
	Protection Class		IP- 55 min. for indoor & IP-65 min for outdoor applications.
	Grounding		To be provided
	Color		RAL 7035
	Spare Terminals		At least 20% unused terminals
2.43	**DATASHEET - LOCAL CONTROL PANEL**		
2.43.1	**Construction**		
	Type		Skid mounted
	Construction		Folded
	Devices & equipments		Panel enclosure, secondary instruments, annuniciation system, selector switch, push buttons, indicating lamps/ led cluster, relays, MCBs, clamp on terminals, plug socket, panel light, space heater, nameplate, earth bus
	Enclosure sheet material		Cold rolled sheet steel
	Enclosure sheet thickness		Minimum 3.0 mm for load bearing sections (mounted with instruments)
			2.0 mm for doors
			Minimum 2.0 mm for other sections
	Height		Minimum 1100 mm
	Frame thickness		Minimum 3.0 mm
	Internal plate thickness		2.5 mm
	Gland plate thickness		3.0 mm
	Cable gland		Double compression
	Base channel		ISMC 100 with anti-vibration mounting & foundation bolts
	Class of protection		IP-55
2.43.2	**Doors**		
	Rear doors		Required with integral lockable handle
	Door locking		Door when locked shall be held at minimum three places.
	Type		Removable type with concealed hinges to facilitate maintenance work
	Suitable pocket inside the door		Required for keeping the drawings / documents
	Double door		Required with suitable glass windows as per the requirement.
2.43.3	**Power & control supply**		
	Input power supply		415V 3 phase AC
	No. Of feeders		Two
	Control supply		230v ac
	Additonal requirement for control supply		MCBs
			Supervisory relay along with a pilot lamp to indicate control supply 'on'
			Auto changeover unit mounted on panel
2.43.4	**Internal wiring**		
	Voltage	V	1100 V
	Material & size		PVC insulated copper multi strand wire /flexible of 1.5mm2, power cable 2.5sqmm
	Routing and runs		Through PVC troughs, AC & DC wires shall be kept separately
	Colour		Separate colours for AC & DC wires
	Ferruling		Cross ferruling
2.43.5	**Painting details***		
	Painting shade & thickness - exterior / interior (these details shall be finalised during detailed		RAL 5012 & minimum 85 microns / glossy white & minimum 70 microns
2.43.6	**Gasket**		

	At door & removable cover		Neoprene
2.43.7	**Ventilation system along with louvers**		
	Cooling fan		2 x 100%, covered with removable wire mesh
2.43.8	**Terminal block**		
	Type		Clip on, separate for AC & DC circuits
	Voltage		1100 V
	Tb points		Cage clamp
	Mounting height from finished floor		>=250 mm
	Spare		20%
	Identification strip		To be provided
2.43.9	**Illumination**		
	Light		Led tubelight
	Shrouded cover	W	15W minimum
	Operating power supply		240V 50 Hz AC
	Operable through		Panel door switch
	Power receptacle		15 Amp, 3-pin
2.43.10	**Earthing studs**		
	Termination to main station earth		Internally with 10 mm bolts at extreme ends for connection
2.43.11	**Alarm annunciator system**		
	No. Of windows	Nos.	Minimum 20
	Facia		Solid state discrete
	Hooter		10W
	Annunciator spare (with electronics)		10% spare window or minimum 2nos. Whichever is more
	Lamp test provision		Required
2.43.12	**Mounting devices on panel**		
	On front side		All operable and indicating devices
	Inside panel		Aux. Relays, terminal, PVC trough, MCBs etc.
	Easy access for operation / maintenance.		Required
2.44	**DATASHEET - VARIABLE FREQUENCY DRIVE (VFD)**		
2.44.1	**OPERATING CONDITIONS**		
	Ambient Temperature		50 Deg
	Relative Humidity		95% at 40DegC
	Rated frequency		50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification
	Voltage level for the VFD output to be fed to motor		415V/690V, Low Voltage, Three Phase AC (LV VFD)
2.44.2	**SYSTEM DESCRIPTION**		
	Type of drive		3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT
	Type of Cooling of VFD		Naturally air cooled/forced air cooled/Liquid cooled
	Converter Type		Full wave diode rectifier/active front end type
	Inverter Type		Thyristor/IGBT/IGCT/SGCT/IEGT
2.44.3	**GENERAL REQUIREMENTS**		
	Design		Modern proven design in power plant/industry
	415 V/690 V LV VFD		Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum Twelve (12) pulse design / 6 pulse with active front end harmonic filter.
			For drives less than 100 KW Six (6) pulse
	Impact of VFD operation on Motors/ cables & supply system		no inherent detrimental impact
	Multiple VFDs for particular application		shall be of same design so as to ensure 100 % interchangeability of components
2.44.4	**TECHNICAL AND OPERATIONAL REQUIREMENTS**		
	System Design		Shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with worst input supply voltage and frequency variation.
			Shall be suitable for the load characteristics and the operational duty of the driven equipment
	Overload capacity of the controller :		
	- for constant torque applications		150% of the rated current for one minute
	- for variable torque applications at rated voltage		110% of rated current for one minute
	- If the motor load exceeds the limit		Automatically reduction of the frequency and voltage to the motor to guard against overload.
	Operating modes		Variable torque changing as a function of speed / Constant torque over a specific speed range / Constant power over a specific speed range / Any other

	Total harmonic voltage and current distortion limits		Shall comply to IEEE 519 & IEC 61000
	Withstanding power		Capable of thermal, dynamic stresses and transient mechanical torque, resulting from short circuit
	Damage control		Any damage resulting from short circuit or internal fault shall be limited to the component concerned.
	Easy access to hardware		To be provided
	Provision for replacement of card (in case of failure)		To be provided
	Allowable speed variation		Within range 10-110% or as per the requirement of driven equipment with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement
	Power Factor for LV VFD		0.95 (minimum)
	Maximum allowable audible noise		85 dB (A) at a distance of one meter under rated loaded with all cooling fan operating conditions.
	Circuit components protection		Suitably protected against over voltages, surges, lightning etc.
	Programmed warning and fault protection function		Display a message in complete English words or Standard English abbreviations
	Drive's fault history		At least 30 time tagged fault messages to be stored
	AC environment for VFDs (>=100KW)		Required
	AC environment for VFDs (<100KW)		Not required
	Fiber optic cable connection		To be provided preferably to ensure high network reliability
2.44.5	**VFD COMPATIBILITY WITH THE MOTOR**		
	Inherent output harmonic resonance		Shall not be present in operating speed range
	Limitations of the motor cable length		VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor, in case of any limitation , the vendor shall clearly state the limitations in the motor cable distance in his proposal
	If cable length becomes critical due to system requirements & constraints		filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics.
2.44.6	**BYPASS ARRANGEMENT (Optional)**		
	Bypass mode		Operation of Motor with VFD bypassed
	Bypass mode operation		During starting (under rated conditions) the motor will be switched on in VFD Mode to limit the starting current and after gaining speed, the load would be switched over to bypass mode.
	Comprehensive motor protection scheme for		Shall be decided during detailed engineering
2.44.7	**STANDBY VFD ARRANGEMENT (Optional)**		
	Common standby arrangement with auto/manual		Required
	Changeover module		Complete protection, interlocks & control required
2.44.8	**EFFICIENCY**		
	Efficiency		Minimum 98%
	Efficiency evaluation parameters		Input transformer, harmonic filters and power factor correction (if applicable), VFD converters, cooling fans and output filter, as applicable in the system. Auxiliary controls : VFD control boards, cooling fans/pumps
	Valid test report		Required
2.44.9	**COOLING SYSTEM**		
	Type		Air cooled Design
	Air-flow pressure switches		Required for monitoring purpose
	Temperature detectors		Required for monitoring purpose
	Cooling fans		Integral to the VFD/ enclosure, If the fan fails, the system must generate the alarm/trip for the fan failure
2.44.10	**MOTOR**		
	Type		Three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application
	Bearings		Insulated bearing on at least one side for motor frame size above 250 frame
	Power Supply Requirement		Solid state power supply consisting of an adjustable frequency inverter for speed control Motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
	Motor Insulation design		To accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800
2.44.11	**OUTPUT FILTER (AS APPLICABLE):**		
	Output/ dv/dt filter		Required for protection of motor from high voltage dv/dt stress. Shall be included within the VFD enclosure

2.44.12	**DC LINK CAPACITOR (AS APPLICABLE):**		
	Type		Self-healing film or electrolytic type having high life time
	Discharge resistors		Required, shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source.
	Suitable for high ripple currents		Yes
2.44.13	**AC/DC Reactor (As applicable)**		
	Type		Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously
	Insulation		Thermal Class 155(F), temperature rise is limited to thermal class 130 (B)
	Noise level		Shall not exceed value specified in NEMA TR-1
2.44.14	**VFD PANEL REQUIREMENTS**		
	Enclosure frames		Required
	Load bearing members		Required
	Cable entry		Bottom of the panel with a removable bolted un-drilled gland plate.
	Protection (as per IS/IEC 60947)		IP: 4X or better for LV VFD
	Enclosure Design Criteria		Shall avoid harmonic and inductive heating effects and to shield any outside equipment from interference, to eliminate any radio frequency interference
	Protection against electromagnetic emissions		To be provided
	Illuminating lamp		Required
	Space heater with switch fuse		Required
	Variable setting thermostat.		Required
	Ventilation using air filters and fans/pumps		Required, to ensure that maximum temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system.
	Terminal block		Separate Terminal block for power and control cable
2.44.15	**LT & HT CABLES**		Required, suitable for VFD system
2.44.16	**CONTROL AND PERFORMANCE REQUIREMENTS**		
	Automatic current limiting feature		Required, to control motor currents during startup and provide a “soft start” torque profile for the motor load combination
	Current and torque limit adjustments		Required
	Drive Speed control		Local or Remote mode
	Local / Remote selection provision		from VFD panel
	Parameter Monitoring		- Input and output voltage of Drive - Input and output current of Drive - Motor speed - Input and output power frequency of Drive -Torque - Output kWhr of Drive - Ambient temperature - Run/stop and local/remote status displayed
	Operator console panel features		Front mounted Backlit alphanumeric display A keypad with keys for parameterization and adjusting parameter Facility / port to connect external hardware Upload and download of all parameter settings from one drive to another drive for start up and operation User-friendly licensed software for operation and fault diagnostic
	Protection features		i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection. ii) Incoming and outgoing line surge protection. iii) Under / over voltage protection iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection. v) Instantaneous Over current & Earth fault protection vi) Converter/Inverter module failure indication. vii) Over frequency/speed protection. viii) Ventilation failure indication & alarm. ix) Over temperature of VFD x) Bearing temperature protection. xi) System earth fault protection. xii) Speed reference loss protection.

	Operator Control PaneL (on the front panel door)		Start / stop (in local/remote mode) Speed control (Raise / lower) Acknowledge/Accept/ Test Push Button for annunciation Auto / Manual / Test Mode select Emergency stop Trip-Remote Breaker
2.44.17	**DIAGNOSTIC FEATURES**		Microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions Information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.
2.44.18	**SERVICEABILITY / MAINTAINABILITY**		
	Power Component Accessibility		All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime
	Marking / Labelling		Sleeve type wire marker tags or other acceptable means of permanent identification shall be applied to power and control wiring. Individual labels shall be provided for all major components of the VFD system
2.45	**Painting color scheme - Impulse piping for water area/equipment**		
	Impulse piping ground color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Sea green, ISC no. 217
2.46	**Painting color scheme - Impulse piping for Oil area**		
	Impulse piping ground color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Light Brown, ISC no. 410
2.47	**Painting color scheme - Impulse piping for Air**		
	Impulse piping ground color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Sky Blue, ISC no. 101
2.48	**Painting color scheme - Impulse piping for LP Dosing / acid / alkali Piping**		
	Impulse piping ground color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Signal Red, ISC no. 537
3.0	**INSPECTION/TESTING**		
3.1	Type Test requirement		Yes
	Item-1		Electronic Transmitters
	Test & Standard -1		As per Standard, BS-6447 / IEC-60770
	Item-2		Control Valve
	Test & Standard -2		CV Test, ISA 75.02 & 75.11
	Item-3		Orifice Plate
	Test & Standard -3		Calibration, ISO 5167
	Test to be specifically conducted		No
	NTPC's approval required. on Test certificate		Yes

CHECK LIST FOR C&I ITEMS

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

MEASURING INSTRUMENTS (1)

Item Components _____ Sub System Assembly	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (As applicable)(R)	Hydro Test(R)	Material Test certificate (R)
Pressure Gauge (IS-3624)	Y	Y	Y	Y	Y				
Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
Electronic Transmitter(IEC-60770)		Y	Y	Y	Y	Y	Y		
Temp. Switch	Y	Y	Y	Y	Y	Y			
Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
Transducer (IS-14570)	Y	Y	Y	Y	Y	Y			
RTD(IS-2848)	Y	Y	Y	Y	Y	Y			
Thermowell	Y		Y				Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable									

MEASURING INSTRUMENTS (2)													
Item Components _____ Sub System Assembly	GA, Dimensions, Paint Thickness ®	Make, Model, Type, Rating BOM®	Process / Electrical connection ®	Calibration/Functional ®	Requirement as per standard ®	WPS approval (A)	Non-destructive testing ®	Calculation for accuracy ®	HV/ IR Test ®	IBR Certification as applicable ®	Hydro test ®	Material test certificate (A)	Integral Testing of complete System
Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y	
Impact head type element	Y	Y	Y					Y				Y	
Electronics Water Level Indicator (EWLI)	Y	Y	Y	Y		Y		Y		Y	Y	Y	Y
Ambient Air Analysers	Y	Y	Y	Y					Y				Y
Analyser & Chiller#	Y	Y	Y	Y			Y	Y		Y	Y	Y	Y
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated. ** As applicable #Vaccuminasation test of chiller assembly													
R-Routine Test A- Acceptance Test Y – Test applicable													

ELECTRICAL ACTUATOR

Test/Attributes Characteristics _____ ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Local/ Remote (Open-Stop-Close) Operation®	Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR with Integral Starter , Non- Intrusive Electrical Actuator (EN15714-2)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

® - Routine Test A - Acceptance Test Y - Test applicable

Note:

1) SIL 2 certificate

PROCESS CONNECTION AND PIPING

Tests _____ Items	Visual & Dimensions ®	component & construction feature, Paint	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	test,Dismantling & reassembly test,Hydrulic impulse and vibration test	Tests as per standards & specification
Local Instrument enclosure	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y*		Y		Y	Y							
Gauge Board	Y	Y		Y		Y		Y		Y	Y			
Impulse pipes and tubes	Y		Y			Y						Y		
Socket weld fittings ANSI B-16.11	Y					Y						Y		Y
Compression fittings	Y					Y					Y	Y	Y	
Instrument valves & Valve manifolds	Y					Y					Y	Y		
Copper tubings ASTM B75	Y					Y								Y
*-applicable for painted junction boxes.														
®-Routine Test A-Acceptance Test Y – Test applicable														

LOCAL CONTROL PANEL (LCP)

Tests Items	Pre Power on Check (#) (R)	Post Power on Check (%) (R)	Internal cabling / Wiring checking(R)	Door Alignment, waviness, and Locking (R)	Louvers, Fans, wire mesh, Lifting arrangement (R)	HV / IR on wired panels (R)	Paint Shade, Thickness and Illumination (R)	Hardware/Make as per BOM (R)	Dimensions, GA, layout (R)
Local Control Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note:

1) These test are minimum requirement.

2) Pre power on check: - Wire dressing, looseness, Availability of Fuses and MCB, Modules are inserted properly, Earthing connection, Input Voltage checking.

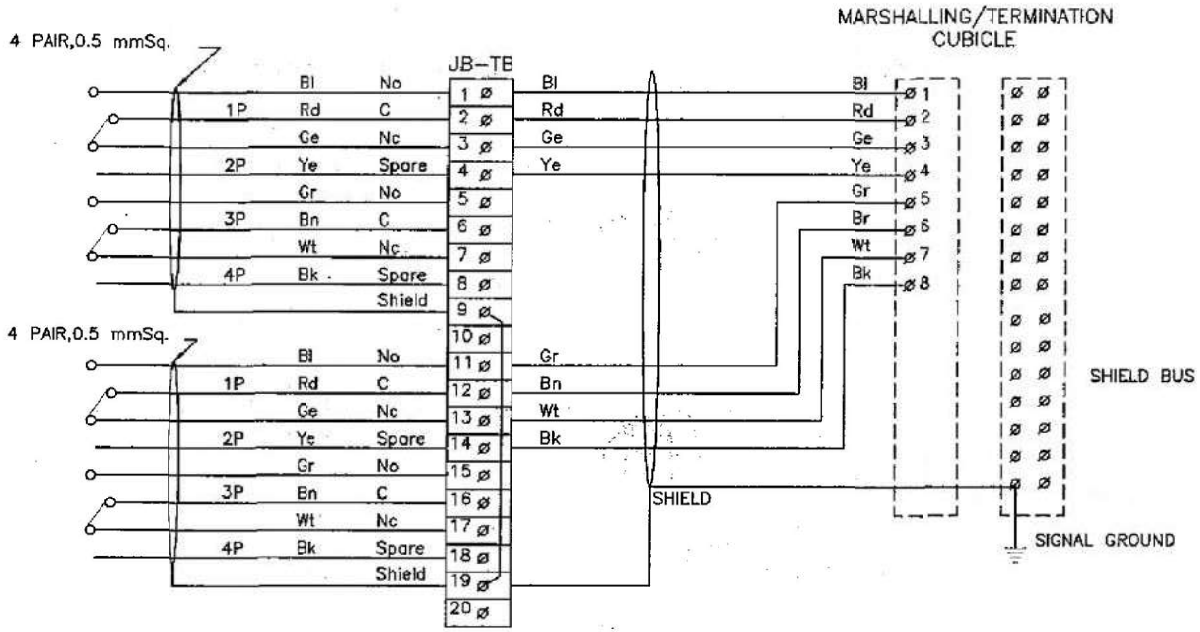
CONTROL VALVE

Tests _____ Items	MAKE,MODEL, TAG	DIMENSION®	SURFACE FINISH®	HEAT TREATMENT®	MATERIAL TEST CERTIFICATES®	IBR CERTIFICATES®	HYDRAULIC TEST , SEAT LEAKAGE ®	UT/RADIOGRAPHY FOR >900 LB RATING®	MPI/DP®	PRESSURE RESISTANCE®	TIMING OPEN/CLOSE®	LINEARITY/HYSTERISIS®	FUNCTIONAL TEST, REVIEW FOR MAKE AND TC OFACCESSORIES®
CONTROL VALVE AND ACTUATOR													
OVERALL	Y	Y	Y			Y	Y				Y	Y	Y
BODY		Y	Y	Y	Y			Y	Y	Y			
BONNET		Y	Y	Y	Y								
TRIM		Y			Y			Y*					
PNEUMATIC ACTUATOR	Y	Y								Y			
ELECTRO PNEUMATIC POSITIONER	Y												Y
®-Routine Test A-Acceptance Test Y – Test applicable													
Y* - UT ON SPINDLE DIA >= 40 MM.													

VARIABLE FREQUENCY DRIVE (VFD) PANEL

Item Components _____ _Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness/	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant IS/IEC
Sheet Steel (IS-513)		Y	Y	Y										
Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987)	Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y										
Control / Selector Switch(IS-6875)					Y	Y	Y							
Contactor/ MCB(IS-13947)					Y	Y	Y							
O/L Protection relays(IS-3231)					Y		Y							
C.T /V.T/ Indicating Meter(IS-2705/3156/1248)					Y	Y	Y							
Fuse/ Fuse carrier(IS-13703)					Y	Y	Y							
Terminals/lugs/pvc wires(IS-13947//IS-694)	Y			Y	Y	Y	Y							
Timers(IS-3231)					Y	Y	Y							
Push Button/ Lamp/ (IS-6875)					Y	Y	Y							
Control Transformer (IS-12021)					Y	Y	Y							
Mimic, Annunciater					Y		Y							
GASKET(IS-11149)		Y	Y	Y	Y		Y							
Fabrication								Y						
Pretreatment & Painting									Y	Y				
VFD panel										Y	Y	Y	Y	Y
®-Routine Test A-Acceptance Test Y – Test applicable														

WIRING DIAGRAM



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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

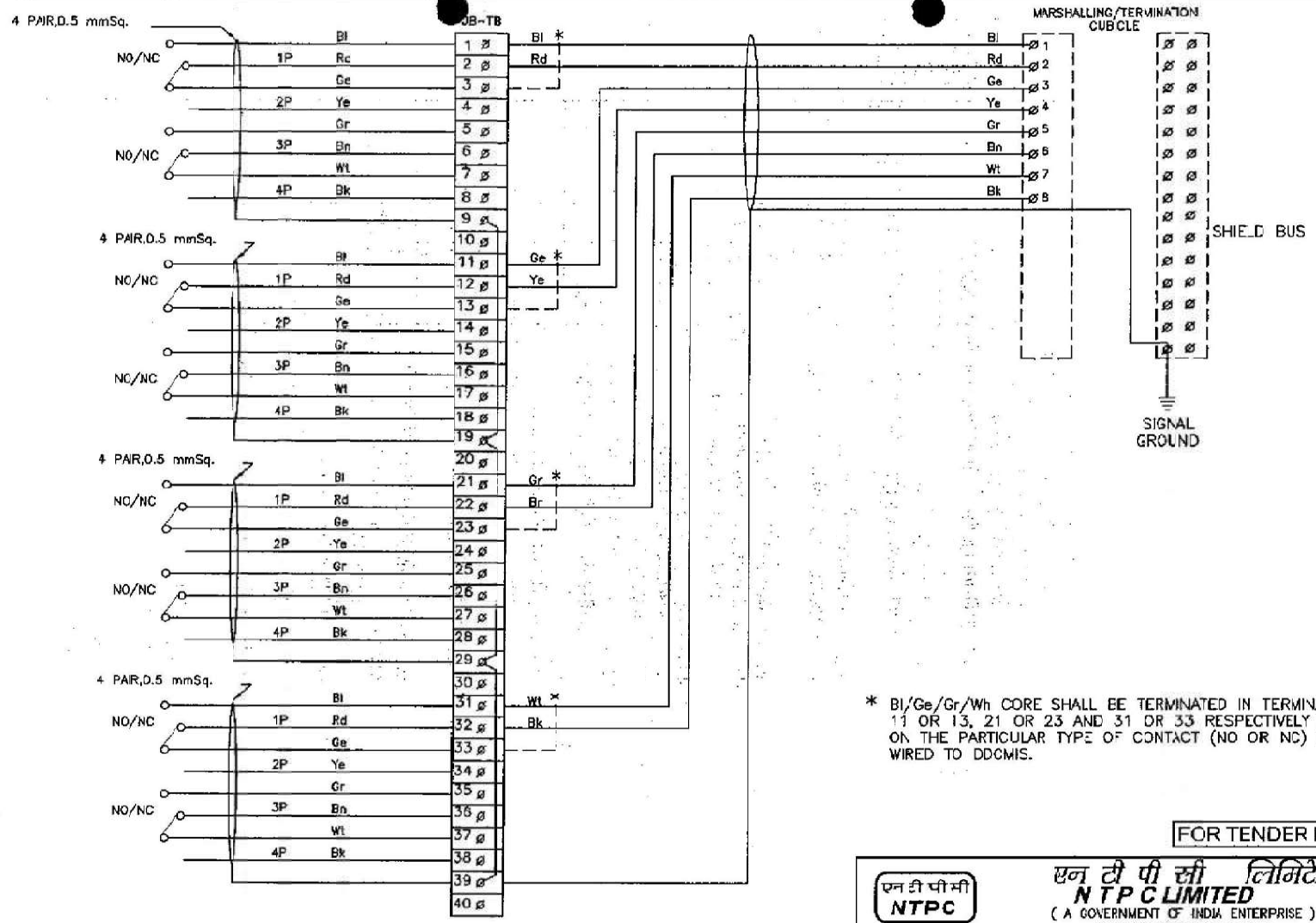
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 14	A



* Bl/Ge/Gr/Wh CORE SHALL BE TERMINATED IN TERMINAL 1 OR 3, 11 OR 13, 21 OR 23 AND 31 OR 33 RESPECTIVELY DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO OR NC) IS TO BE WIRED TO DDCMIS.

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ENGINEERING DIVISION

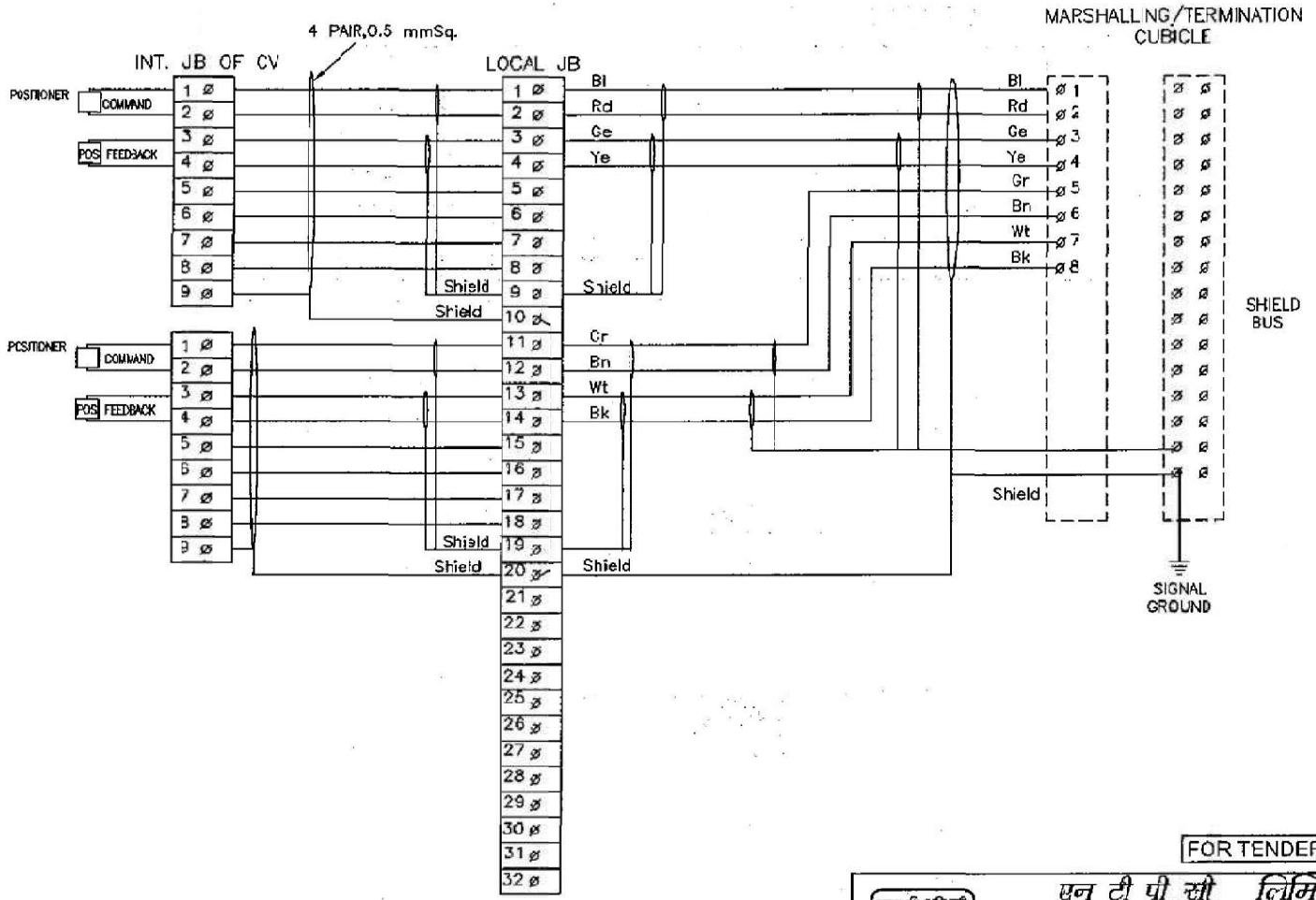
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
SWITCH TERMINATION DETAILS
NO/NC

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 02 OF 14	A



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NTPC LIMITED
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ENGINEERING DIVISION

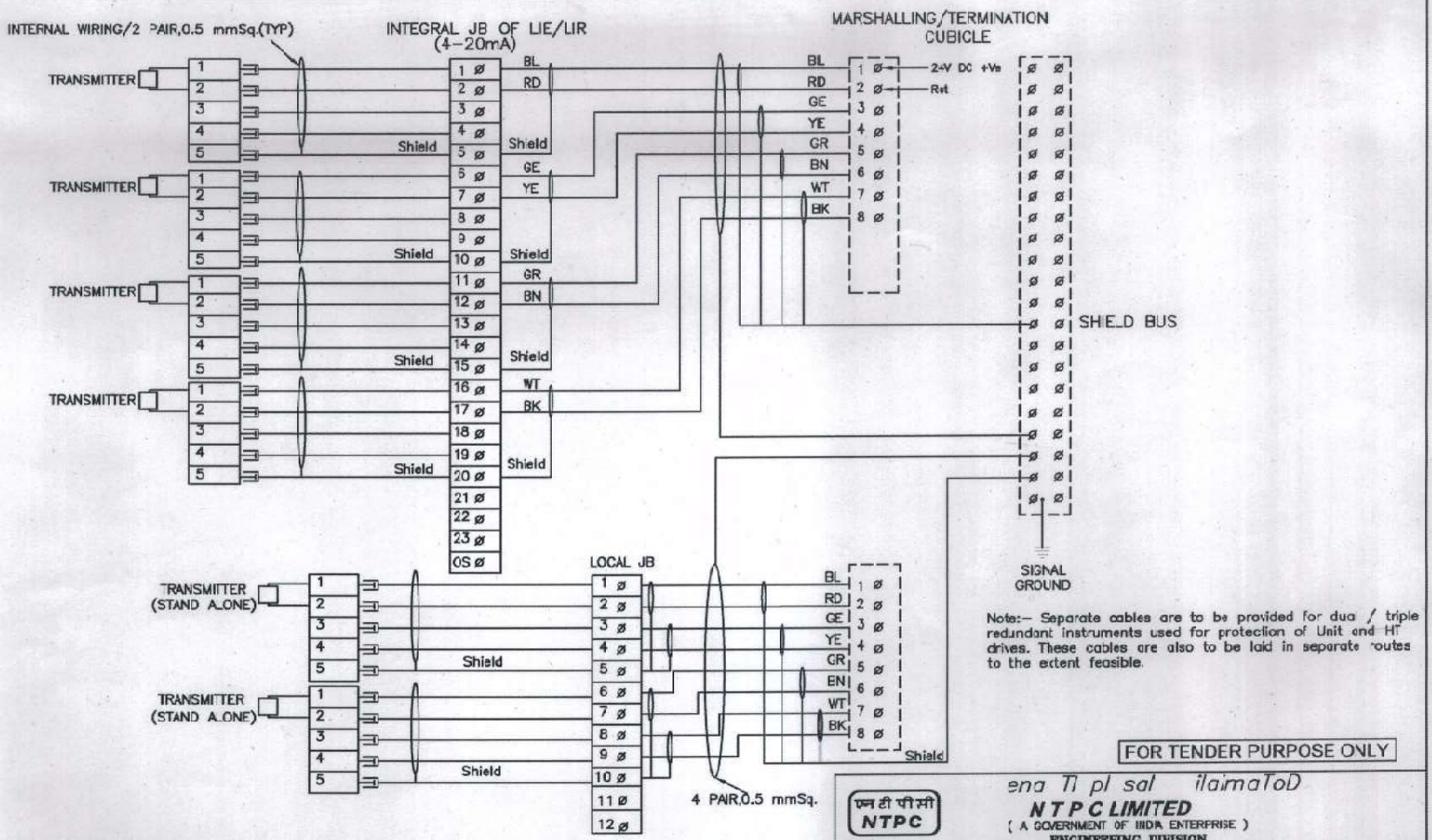
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS CONTROL VALVE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	AFPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 03 OF 14	A



Note:– Separate cables are to be provided for dua / triple redundant instruments used for protection of Unit and HT drives. These cables are also to be laid in separate routes to the extent feasible.

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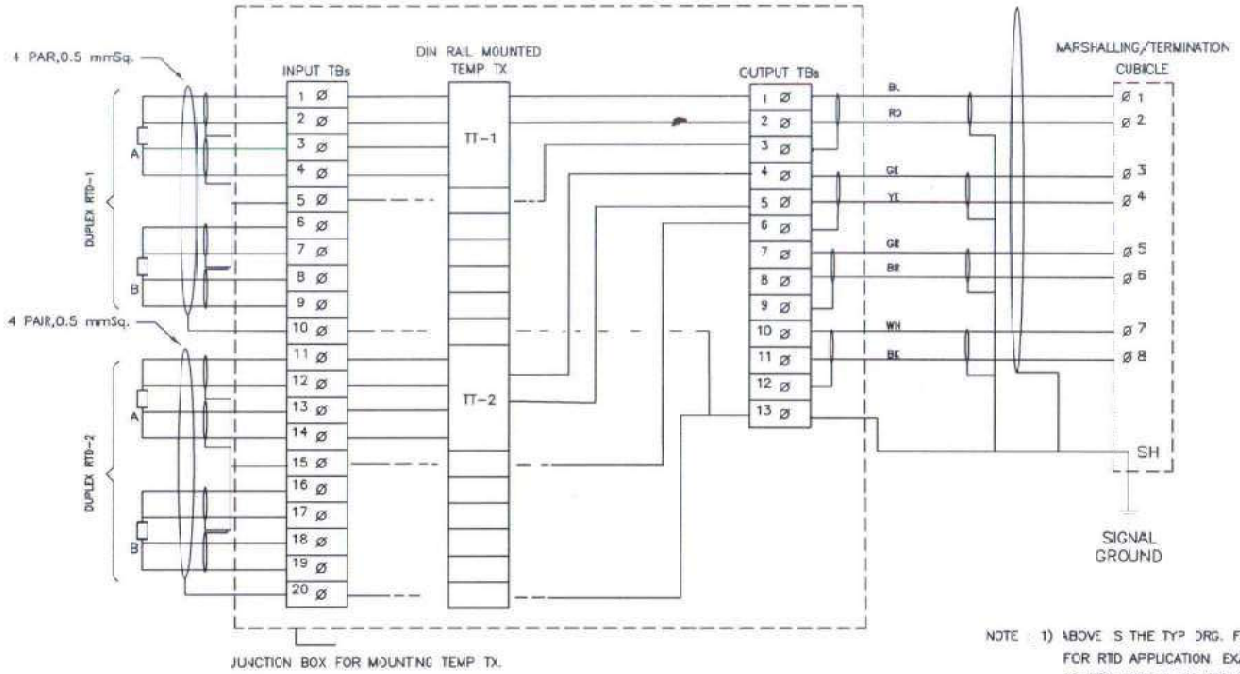
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
C	NOTE REGARDING CABLE IS ADDED.										10.12.13
B	INTERNAL WIRING FOR LIE/LIR MOUNTED SHOWN WIRING OF STAND ALONE TXTR SHOWN										10.12.06
A	FIRST ISSUE										12.1.05

CLEARED BY

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS 4-20mA

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-035 SH 04 OF 14	C



NOTE 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.
2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

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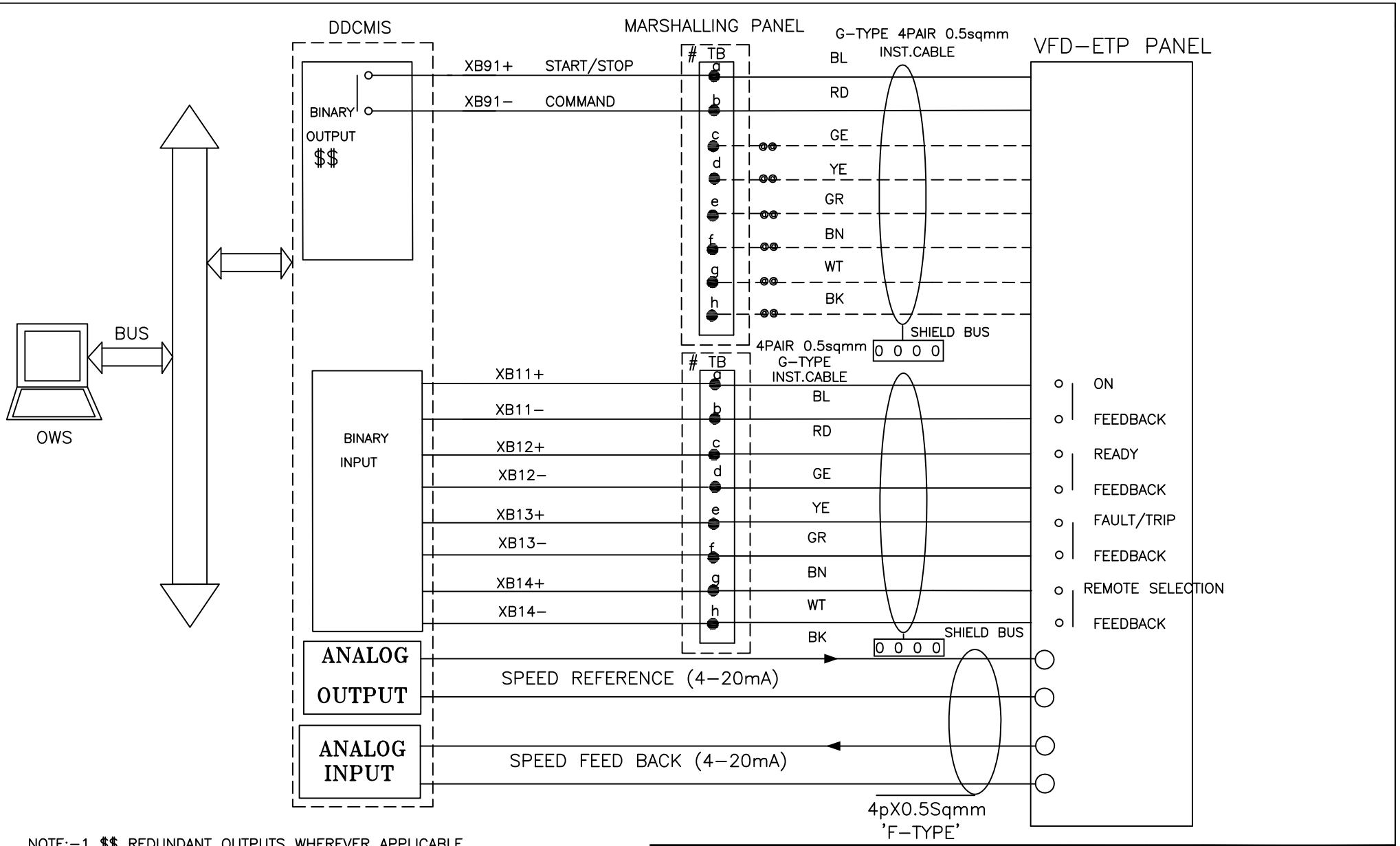
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBs

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										25.04.06
					CLEARED BY						

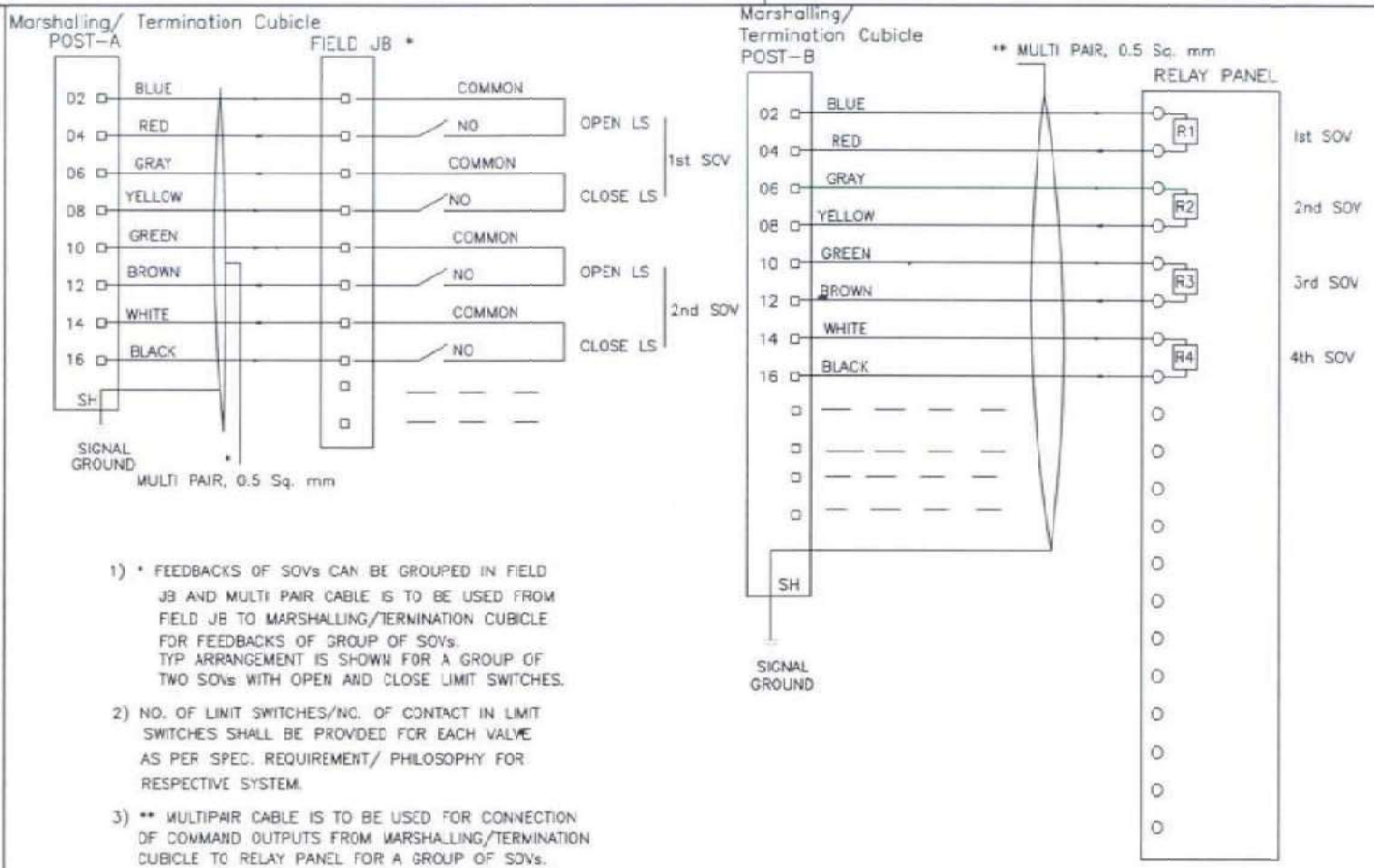
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 06 OF 14	C

DDCMIS INTERFACE WITH VFD OF ETP (VFD-ETP)



NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 OTHER VFD SIGNALS WILL BE CONSIDERED AS PER IO LIST. SAME SHALL BE DECIDED DURING DETAIL ENGINEERING.

BHEL	DDCMIS INTERFACE WITH VFD OF ETP (VFD-ETP)	DRG.NO.	
		SHT	13 OF 34



1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NC. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.

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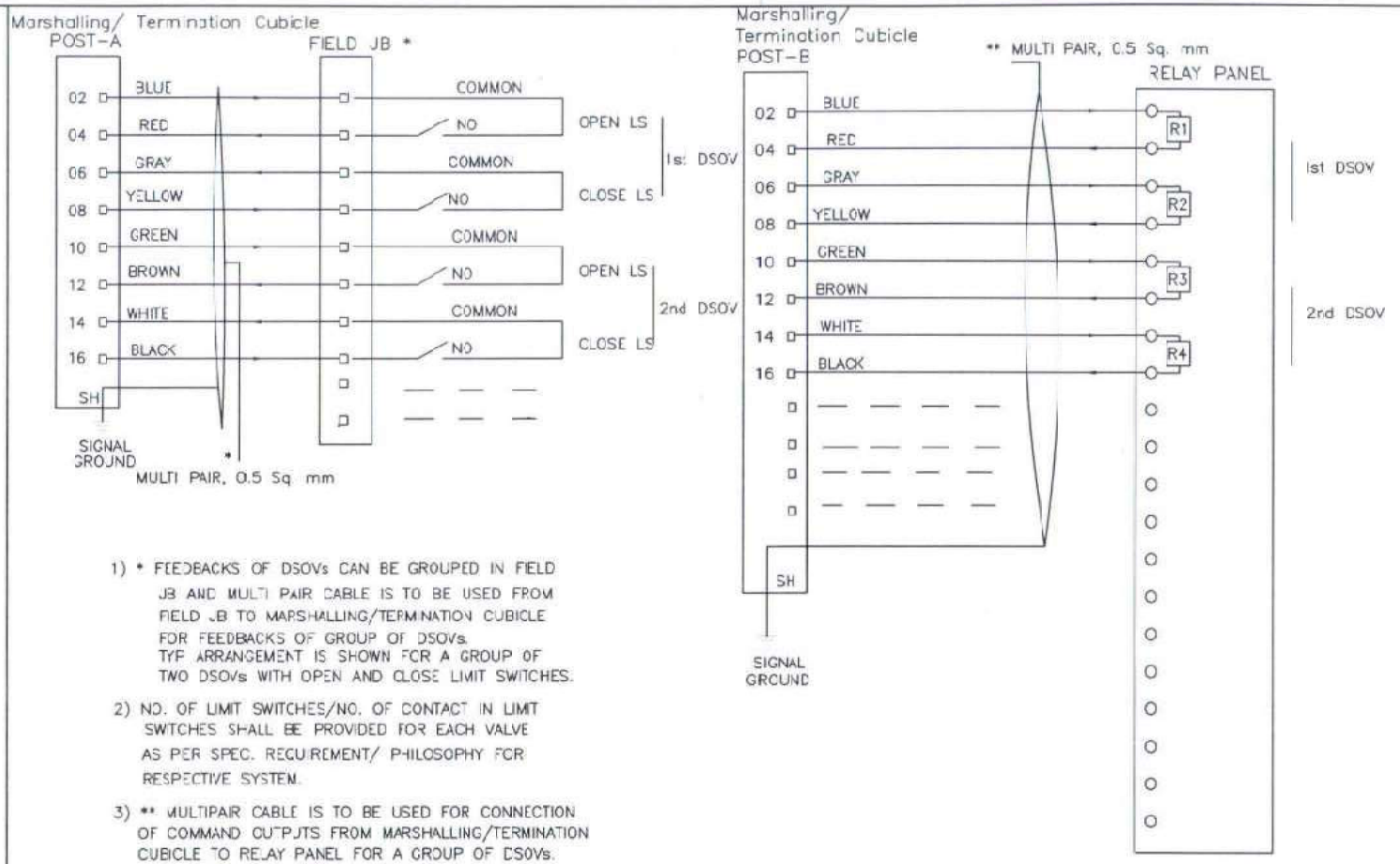
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	FIRST ISSUE										30.10.02
		CLEARED BY									

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 08 OF 14	C



1) * FEEDBACKS OF DSOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO DSOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEN.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.

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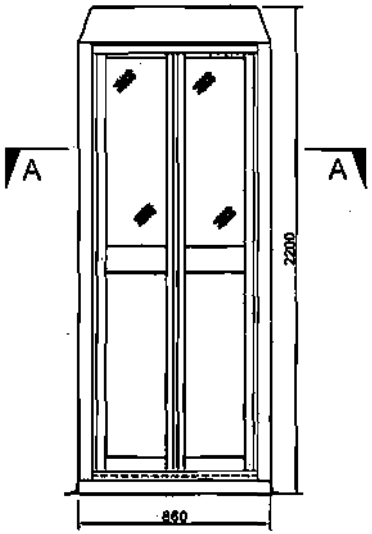
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	FIRST ISSUE										30.10.02

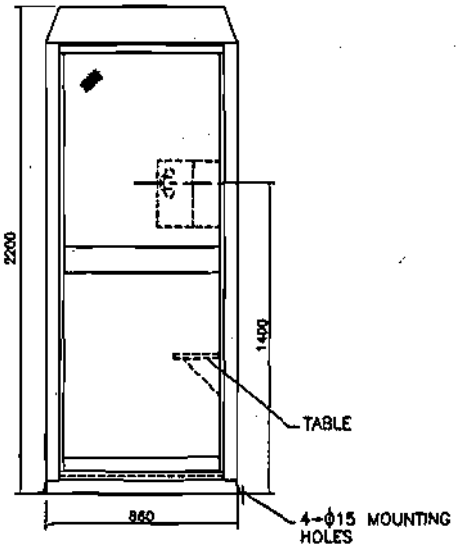
CLEARED BY

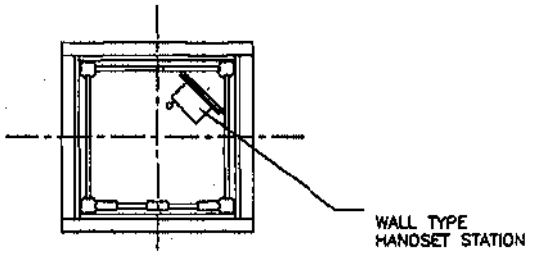
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(DOUBLE COIL SOLENOID)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-FOI-A-065 SH 09 OF 14	C







SECTION A–A

NOTES

1. LOCATIONS SHALL BE FINALISED DURING DETAILED ENGINEERING.

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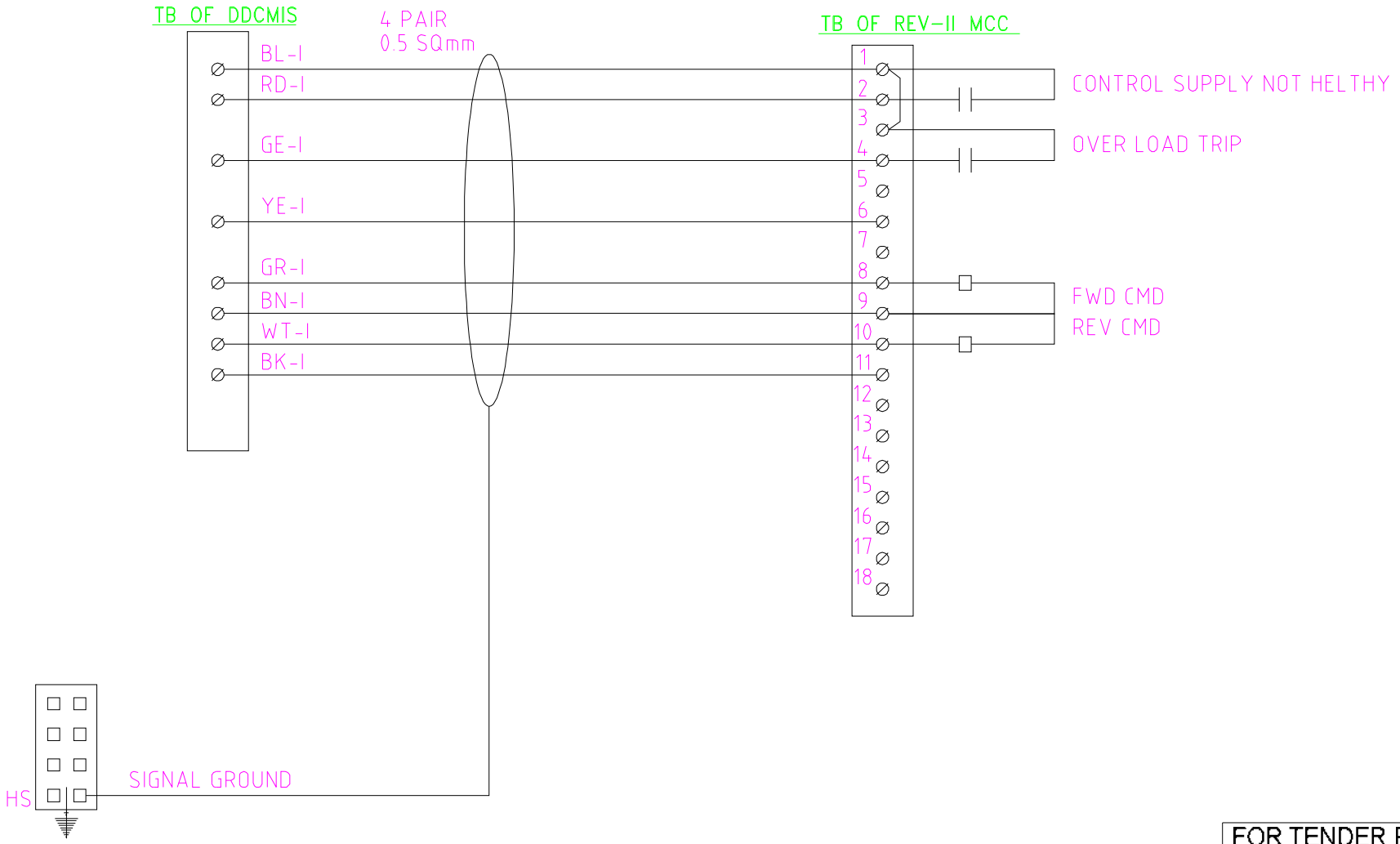
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: ACOUSTIC HOOD OUT LINE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-070	A



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National Thermal Power Corporation Ltd.

(A GOVERNMENT OF INDIA ENTERPRISE)

ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT CHP

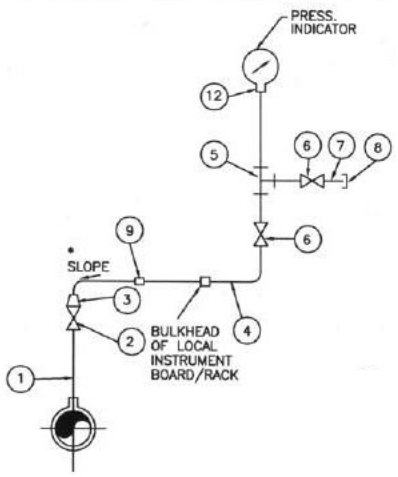
TITLE: INTERFACE OF DDCMIS WITH MCC /SWGR/LCP (REV-II)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										11.01.17

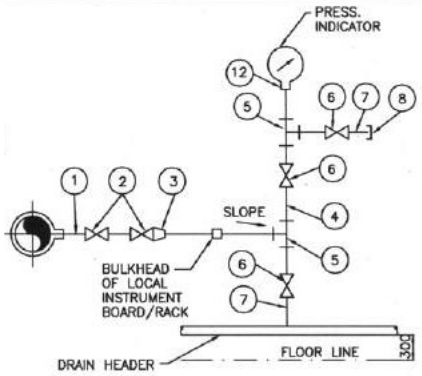
CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-155-POI-A-065 SH 07	A

HOOK UP DIAGRAM FOR C&I ITEMS

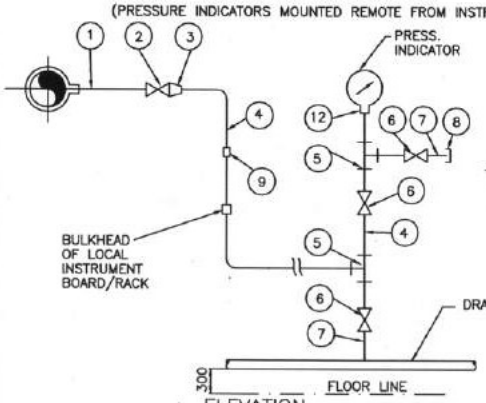


ELEVATION
INST./ SERVICE AIR

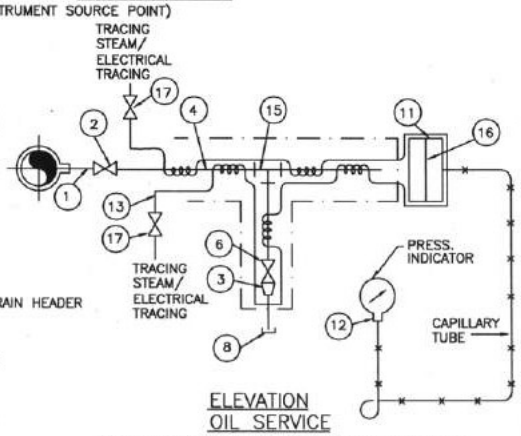


ELEVATION
LIQUID SOURCE
(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



ELEVATION
LIQUID SOURCE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)



ELEVATION
OIL SERVICE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" , 3/4" , 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1' SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE.
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	6" SS SYPHON
11.	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER.
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS,1/4"SW

NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
6. * SLOPE APPROX. 50 MM / METRE.

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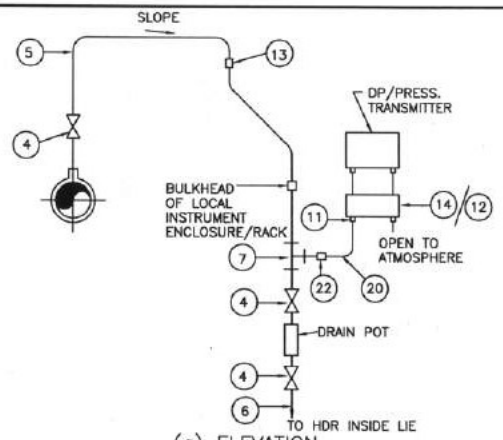
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
		CLEARED BY									

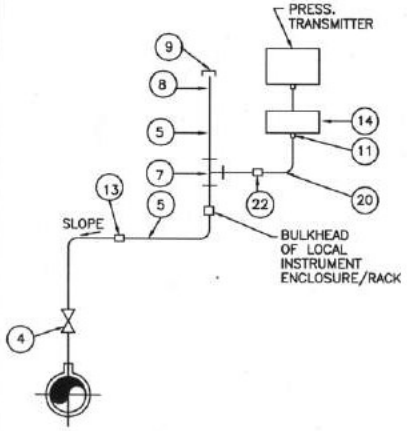
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

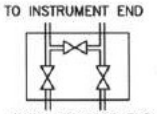
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-022	A

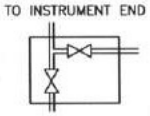


(a) ELEVATION
INST/SERVICE AIR PRESSURE MEASUREMENT
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION
INST/SERVICE AIR PRESSURE MEASUREMENT
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT





LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42 X 405 MM M.S. BLACK PIPE
2.	M42x2 TO 3/4" REDUCING INSERT
3.	M42x2(F) M.S.CAP
4.	3/4" SW GLOBE VALVE/GATE VALVE
5.	3/4" NPS PIPE
6.	3/4" NPS SW 3/4" NPT(M) CS/AS NIPPLE
7.	3/4" SW EQUAL TEE
8.	3/4" NPS SCH 80 CARBON/ALLOY STEEL NIPPLE
9.	3/4" NPT(F) CS/AS CAP
10.	3/4" SW CS/AS EQUAL CROSS
11.	1/2" TUBE ADOPTER
12.	3 VALVE MANIFOLD
13.	3/4" PIPE UNION
14.	2 VALVE MANIFOLD
15.	3/4" SW 4 WAY VALVE
16.	QUICK DISCONECT FITTING
17.	3/4"SWx1/2"SW BRANCH TEE
18.	1/2" NB SEAMLESS GI PIPE
19.	1/2" NPT (F) GI FITTING
20.	SS TUBE
21.	FLEXIBLE HOSE WITH ONE END SOCKET WELDED (PIPE SIDE) & OTHER END WITH SUITABLE FITTINGS.
22.	3/4" x 1/2" S.S. TUBE UNION

NOTES:-

1. SEE NOTES UNDER DRG. NO.0000-999-POI-A-022.
2. IMPULSE LINE DRAIN CONNECTIONS SHALL BE DONE AS PER TECHNICAL SPECIFICATIONS
3. THE SLOPE IN THE HORIZONTAL OF THE IMPULSE PIPE SHALL BE APPROX. 50 mm/mtr.
4. THE EXACT ORIENTATION OF THE TRANSMITTERS WITH RESPECT TO VALVE MANIFOLDS ETC. WILL BE FINALISED DURING DETAILED ENGINEERING KEEPING IN VIEW THE MANUFACTURER'S RECOMMENDATIONS.
5. COMMON INSTRUMENT AIR HEADER (1"NB) USING REDUNDANT AIR FILTER REGULATORS WILL BE MADE IN EACH TRANSMITTER ENCLOSURE REQUIRING PURGE AIR. PURGE AIR FOR EACH INSTRUMENT LINE SHALL BE TAPPED FROM THIS HEADER USING INDIVIDUAL PURGE ROTAMETERS AS SHOWN IN DRG. NO. 0000-999-POI-A-034 TYPICALLY.

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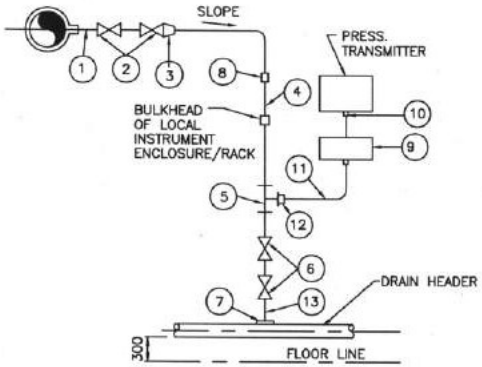
PROJECT: TYPICAL THERMAL POWER PROJECT

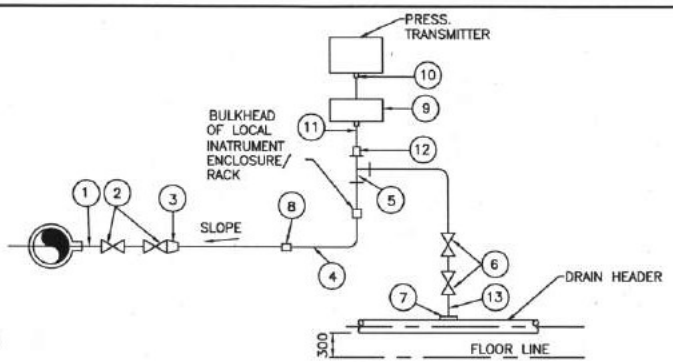
TITLE: INSTRUMENT INSTALLATION DIAGRAM
(PRESSURE MEASUREMENT USING PRESS / DP TRANSMITTERS
(INST./SERVICE, DIRTY AIR/FLUE GAS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-023	A



ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



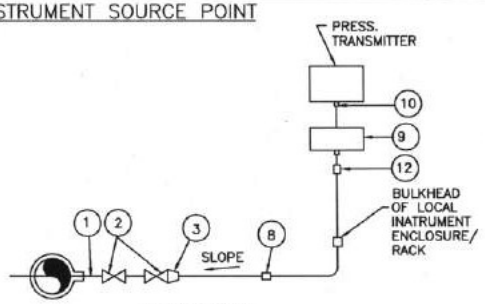
ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" / 3/4" /1" NPS SCH. 80/160/XXS/P91 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	3/4"/1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEE
6.	1/2"SW GLOBE VALVE
7.	1/2"NPS SCH. 80/160 SWx1/2"CS/AS COUPLER
8.	1/2" PIPE UNION
9.	2/3 VALVE MANIFOLD (FOR DETAIL SEE DRAWING NO.0000-102-POI-A-023.
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE x 1/2"TUBE UNION
13.	1/2"NPS SCH. 80/160 SWx1/2" NPT(M) CS/AS NIPPLE



ELEVATION

VACCUM PRESSURE MEASUREMENT

NOTES:-

1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

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A	FIRST ISSUE							T.G.			21.08.12
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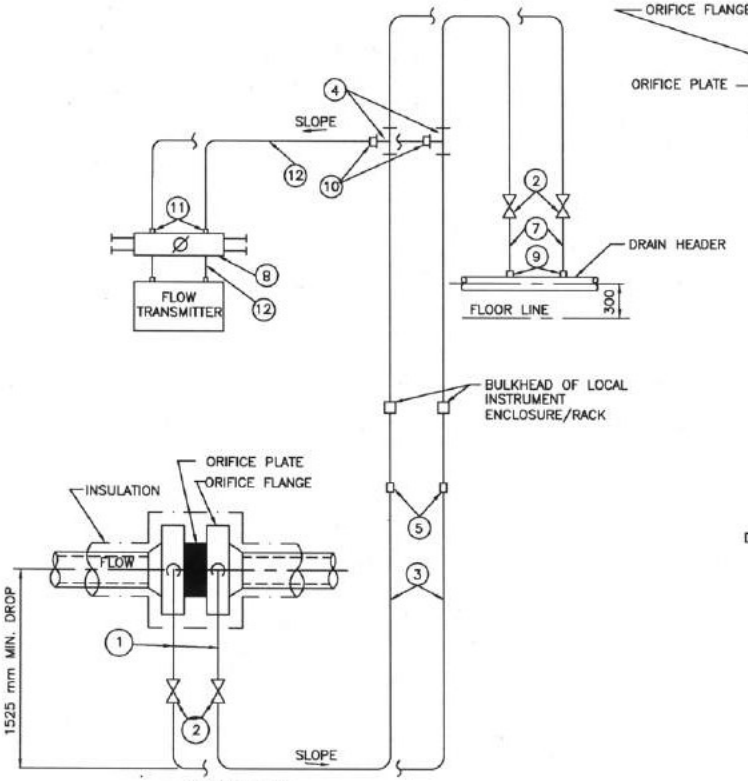
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)

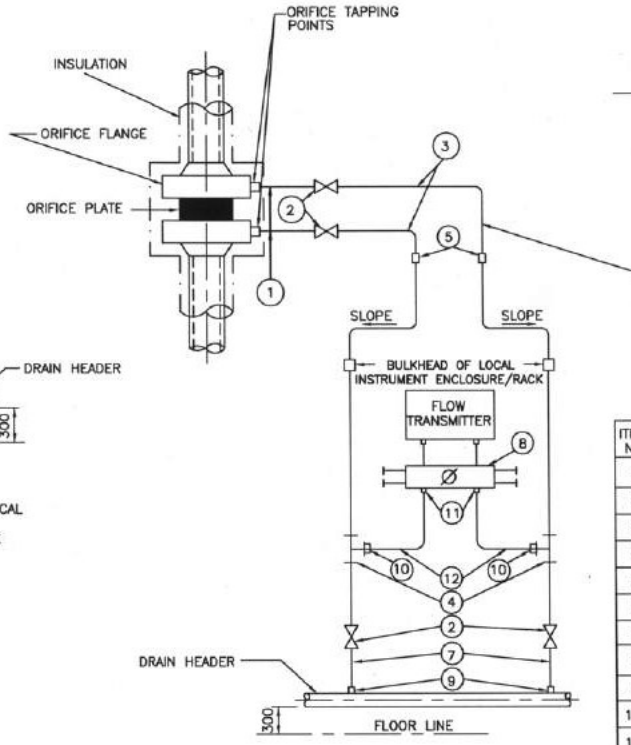
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-025	A



ELEVATION

HORIZONTAL PIPE RUN

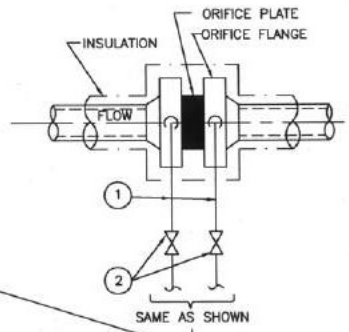
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION

VERTICAL PIPE RUN

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

HORIZONTAL PIPE RUN

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2"NPS SCH. 80 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE WITH NECESSARY ATTACHMENT TO FLANGE OF ORIFICE
2.	1/2"SW GLOBE VALVE.
3.	1/2" NPS PIPE
4.	1/2" SW EQUAL TEE
5.	1/2" PIPE UNION
6.	–
7.	1/2"NPS SCH. 80 SWx1/2"NPT (M) S.S. NIPPLE
8.	5 VALVE MANIFOLD FOR DETAIL REFER DRAWING NO.0000-102-POI-A-026.
9.	1/2" T SW HALF COUPLET
10.	1/2" PIPE x 1/2" TUBE UNION
11.	SUITABLE ADAPTER
12.	SS TUBE

NOTES:–

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

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A	FIRST ISSUE							T.G.			21.08.12

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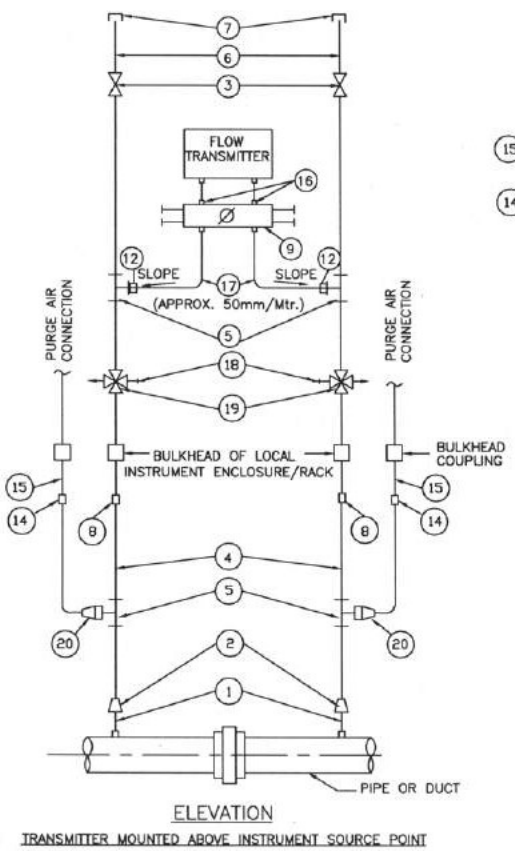
PROJECT: TYPICAL THERMAL POWER PROJECT

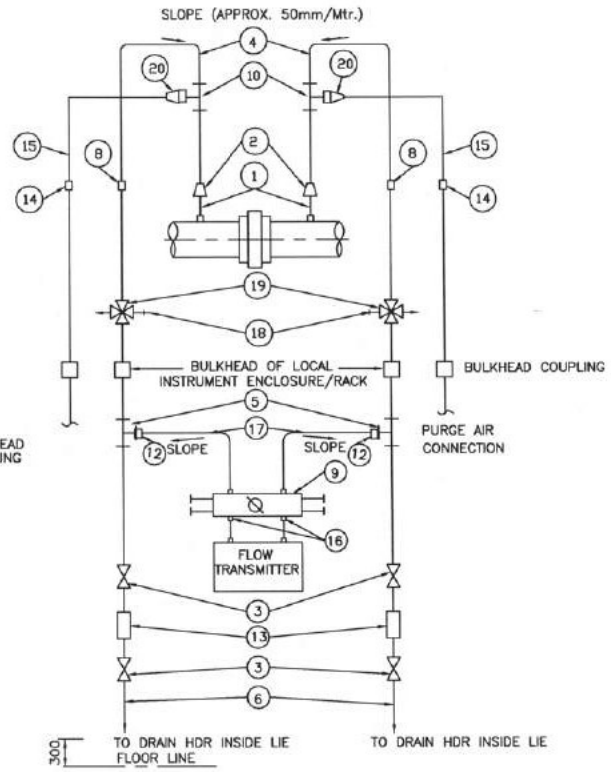
TITLE: INSTRUMENT INSTALLATION DIAGRAM
FLOW MEASUREMENT (USING ORIFICE PLATES)
CONDENSATE & SERVICE WATER

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-027	A



ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x4.05mm M.S. BLACK PIPE.
2.	M 42x2 TO 3/4"SW REDUCING INSERT.
3.	3/4" SW GLOBE VALVE.
4.	3/4" PIPE.
5.	3/4" SW EQUAL TEE.
6.	3/4" SCH. 80 SWx3/4" NPT (M) CS/AS NIPPLE
7.	3/4" NPT (F) CAP.
8.	3/4" PIPE UNION.
9.	5 VALVE MANIFOLD FOR DETAIL REFER DRAWING NO.0000-102-POI-A-026.
10.	3/4" SW EQUAL TEE.
11.	3/4" SW GATE VALVE.
12.	3/4" PIPE x 1/2" TUBE UNION
13.	DRAIN POT.
14.	1/2" GI FITTING
15.	1/2" NB GI PIPE
16.	SUITABLE ADAPTER
17.	SS TUBE
18.	QUICK DISCONNECT FITTINGS.
19.	3/4" SW 4 WAY VALVE.
20.	3/4" x1/2" REDUCER.

NOTES:-

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

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AIR/GAS FLOW MEASUREMENT USING HEAD TYPE PRIMARY ELEMENT

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12

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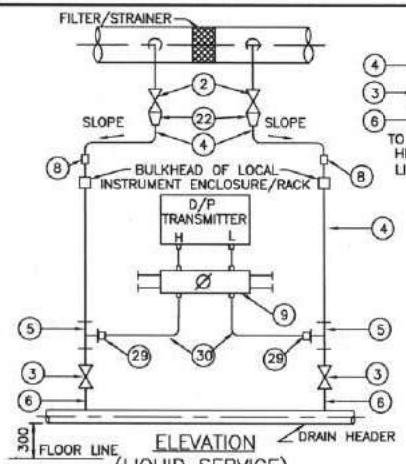
PROJECT: TYPICAL THERMAL POWER PROJECT

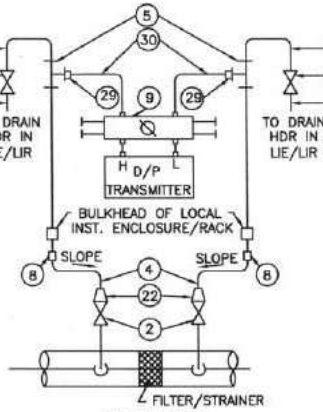
TITLE: INSTRUMENT INSTALLATION DIAGRAM (FLOW MEASUREMENT AIR/GAS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-028	B



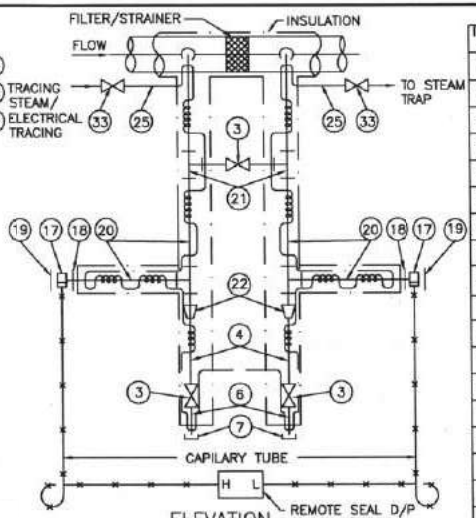
ELEVATION
(LIQUID SERVICE)

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

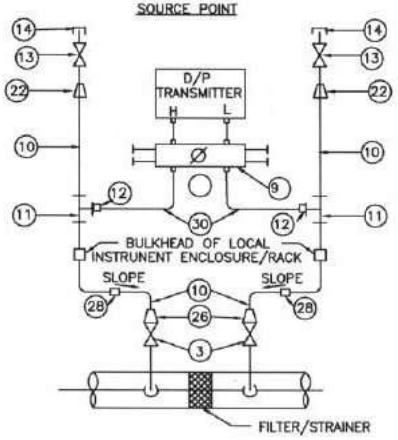


ELEVATION
(LIQUID SERVICE)

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION
OIL SERVICE



ELEVATION
CLEAN GAS/AIR SERVICE

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
DIFFERENTIAL PRESSURE MEASUREMENT

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

FOR TENDER PURPOSE ONLY

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x2 TO 3/4" SW REDUCING INSERT.
2.	3/4" SW GLOBE VALVE.
3.	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4"/1" IN GAS/AIR APPLICATION
4.	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7.	1/2" NPT (F) CAP.
8.	1/2" PIPE x 1/2" PIPE UNION.
9.	5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000-999-POI-A-026.
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4"/1/2" SW EQUAL TEE.
12.	3/4"x1/2" TUBE UNION.
13.	1/2" SCREWED GLOBE VALVE.
14.	1/2" NPT (M) PLUG.
15.	3/4" SW GATE VALVE.
16.	3/4" SW EQUAL CROSS.
17.	WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.
18.	3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE.
19.	3" BLIND FLANGE.
20.	1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEE.
22.	3/4" x 1/2"SW REDUCING INSERT.
23.	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24.	3/4" NPT (F) CS/AS CAP.
25.	1/4" NPS ALLOY STEEL PIPE.
26.	1" x 3/4" SW REDUCING INSERT.
27.	3/4" SW x 1/2" PSW BRANCH TEE.
28.	3/4" PIPE UNION
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30.	SS TUBE
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTINGS.
33.	1/4" SW ISOLATION VALVE 316SS
34.	1/2" x 1/2" SS PIPE UNION.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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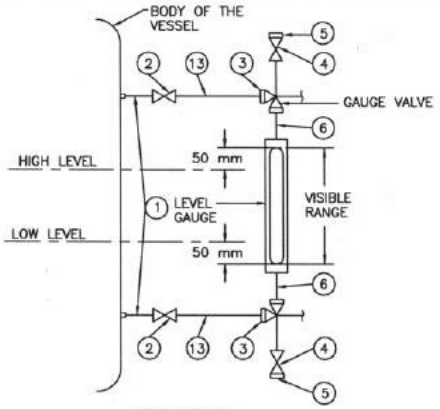
PROJECT: TYPICAL THERMAL POWER PROJECT

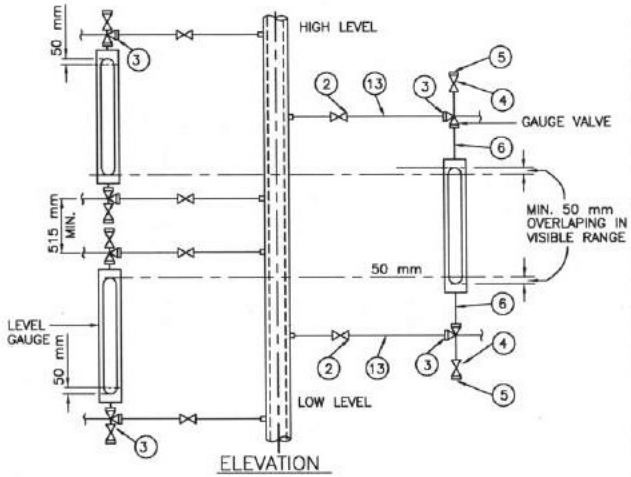
TITLE: INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-030	A



ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS



ELEVATION

LOCAL LEVEL INDICATION USING MULTIPLE GAUGES
FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4"/1" NPS SCH.40/80/160/P91 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	3/4" SW GLOBE VALVE.
3.	3/4" SW UNION.
4.	3/4" NPT GLOBE VALVE.
5.	3/4" NPT (M) CAP.
6.	3/4" NPT (F) UNION CONNECTION.
7.	1" SW EQUAL UNION.
8.	1" x 1/2" SW REDUCING INSERT.
9.	1" SW EQUAL TEE.
10.	1/2" SW GLOBE VALVE.
11.	1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
12.	1/2" NPT (F) CAP
13.	3/4"x1/2" NPS SCH.40/80 CS/AS PIPE.
14.	1/2" NPS SCH.80/160 CS/AS NIPPLE.
15.	1" SW GLOBE VALVE.

NOTES:-

1. FOR LEVEL GAUGE 3/4" AND FOR LEVEL SWITCH 1" PROCESS CONNECTION SHALL BE PROVIDED.
2. NOTES UNDER DRG. NO. 0000-999-POI-A-023 (WHICHEVER ARE RELEVENT).

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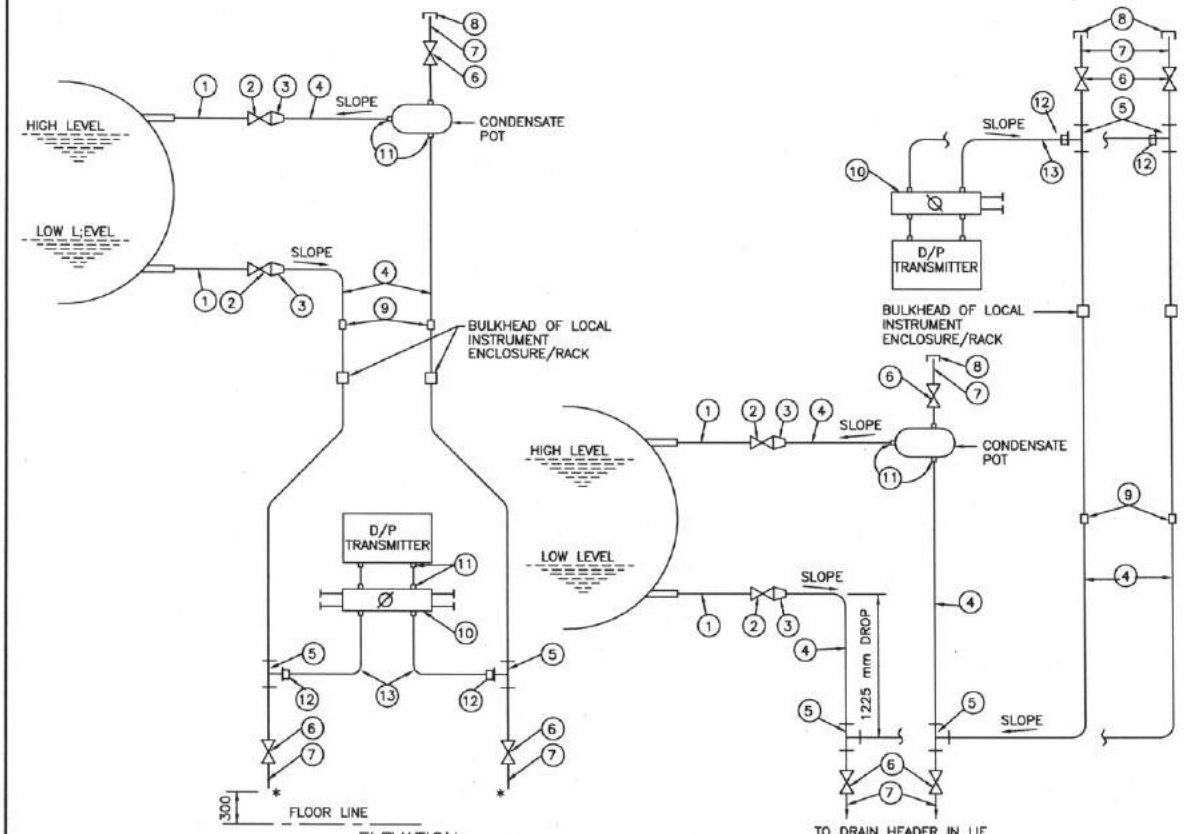
ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							F.G.			21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-031	A



ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1" NPS SCH.40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT.
4.	1/2" NPS SCH.80/160/XXS(AS PER PROCESS REQ.)CS/AS PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" SW GLOBE VALVE.
7.	1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
8.	1/2 NPT (F) CAP.
9.	1/2" PIPE UNION.
10.	5-VALVE MANIFOLD (FOR DETAILS REF. DRG. NO.0000-999-POI-A-026.
11.	SUITABLE ADAPTER.
12.	1/2" PIPE x 1/2" TUBE UNION.
13.	S.S. TUBE.

NOTES:-

1. SAME NOTES AS UNDER DRG. NO.0000-999-POI-A-023. (WHICHEVER ARE RELEVENT).

* TO DRAIN HEADER IN LIE/LIR.

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LEVEL MEASUREMENT OF CLEAR NON-VISCOUS OR NON-CORROSIVE LIQUID IN CLOSED VESSEL WITH CONDENSABLE ATMOSPHERE USING D/P TRANSMITTER

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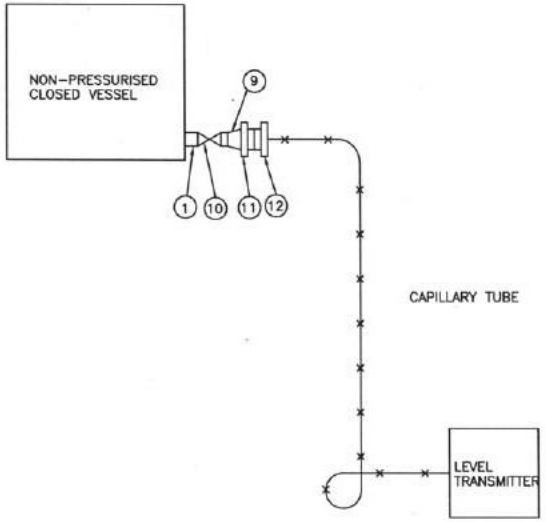
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

CLEARED BY

PROJECT: TYPICAL THERMAL POWER PROJECT

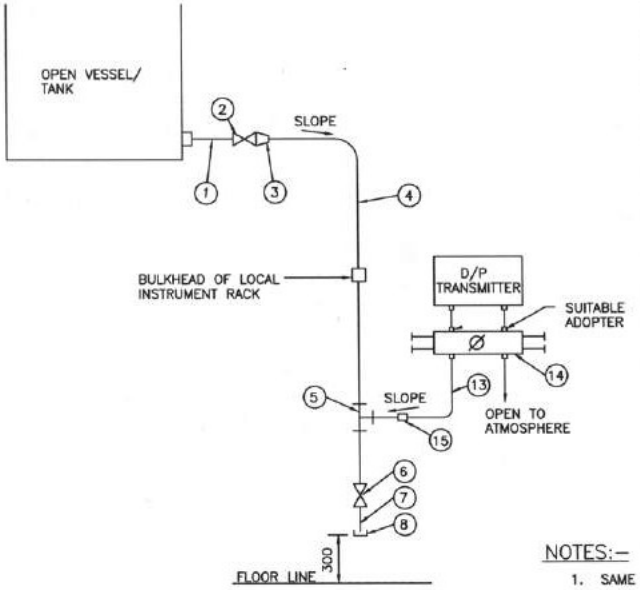
TITLE: INSTRUMENT INSTALLATION DIAGRAM
(LEVEL MEASUREMENT USING D/P TRANSMITTERS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-032 SH 1 OF 2	A



ELEVATION

LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID IN CLOSED VESSEL USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER WITH REMOTE SEAL



ELEVATION

LEVEL MEASUREMENT OF CLEAN LIQUID IN AN OPEN VESSEL USING D/P TRANSMITTER

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4"/ 1" NPS 40/80 PIPE.
2.	3/4" SW GLOBE VALVE.
3.	3/4"/ 1/2" SW REDUCING INSERT.
4.	1/2" NPS SCH. 40/80 PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" SW GLOBE VALVE.
7.	1/2" NPS SWx1/2" NPT(M) NIPPLE.
8.	1/2" NPT (F) CAP.
9.	3/4" TO 4" EXPANDER.
10.	3/4" BUTT WELDED GATE VALVE.
11.	4" ANSI 300 lbs R.F. WELD NECK FLANGE.
12.	4"ANSI MATCHING FLANGE WITH FLUSH DIAPHRAGM OF LEVEL TRANSMITTER
13.	SS TUBE.
14.	3-VALVE MANIFOLD (FOR DETAIL REF. DRG. NO. 0000-999-POI-A-023.
15.	1/2" PIPE x 1/2" TUBE UNION.

NOTES:-

1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

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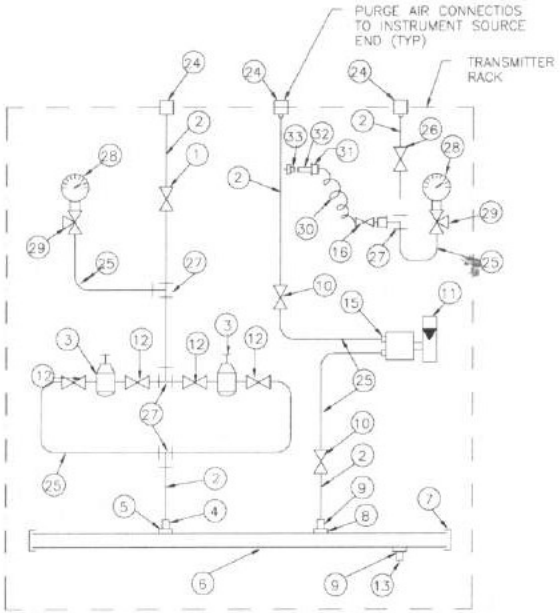
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

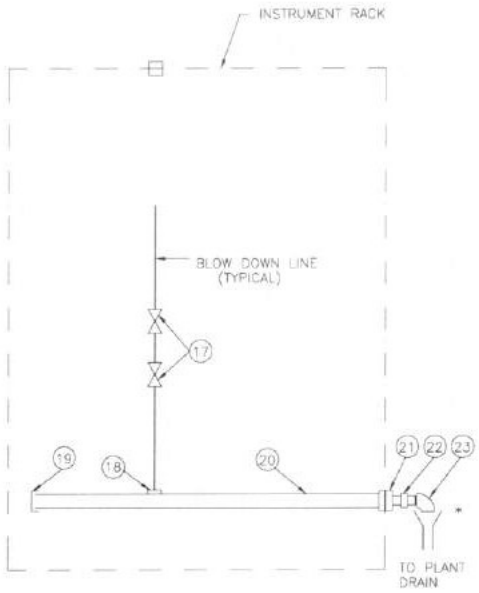
TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT-OPEN VESSEL)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-033	A



TYPICAL PURGE AIR CONNECTION INSIDE THE INST. ENCLOSURE

(APPLICABLE FOR AIR & FLUE GAS SERVICE INSTRUMENTS REQUIRING PURGE AIR)



TYPICAL BLOW DOWN HEADER CONNECTION INSIDE THE INSTRUMENT RACK/ENCLOSURE

**

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	ISOLATION VALVE(gate/globe) SS.
2.	1/2" O.D. SEAMLESS SS PIPE.
3.	1/2" NPT (F) AIR FILTER REGULATOR
4.	1/2" NPT x 1/2" O.D. (M) CONNECTOR SS.
5.	1/2" NPT (F) COUPLET SS.
6.	1" NB INST. AIR HEADER SS.
7.	1" PSB END CAP SS
8.	1/2" NPT (F) COUPLET SS.
9.	1/2" NPT x 1/2" O.D. (M) CONNECTOR SS.
10.	1/2" COMP. NEEDLE VALVE SS.
11.	1/2" NPT (F) AIR PURGE SET.
12.	1/2" NPT (M) x 1/2" COMP. VALVE SS.
13.	1/2" NPT PLUG SS.
14.	
15.	1/2" TUBE SS CONNECTOR.
16.	1/2" TUBE COMP. EQUAL TEE UNION.
17.	DRAIN VALVE 1/2" SW FOR WTR/STM/COND & 3/4" FOR AIR/FLUE GAS.
18.	1/2" SW HALF COUPLET
19.	2" SW CAP SS.
20.	2" NB ASTMA 105 GR. B SCH.80 BLOWDOWN HEADER
21.	2" PSW x 1" NPT (F) COUPLING.
22.	1" NPT x 1" BSP HEX NIPPLE.
23.	1" BSP ELBOW.
24.	BULKHEAD-SS 1/2" SWx1/2"NB THREADED, SUITABLE FOR GI PIPE CONNECTION
25.	1/2" O.D. SEAMLESS TUBE SS.
26.	1/2" SW PRESS. GAUGE ISOLATION VALVE SS
27.	1/2" TUBE x 1/2" NPT (F) BRANCH TEE SS.
28.	4" DIAL x 1/2" NPT PR. GAUGE.
29.	1/2" SW x 1/2" NPT (F) PR. GAUGE VALVE SS.
30.	1/2" I.D. NYLON FLEX. HOSE BRAIDED WITH SS WIRE.
31.	1/2" NPT (M) x 1/2" HOSE BARBED CONN. SS.
32.	1/2" NPT (F) QUICK DISCONNECT SS.
33.	1/2" NPT (M) QUICKDISCONNECT SS.

NOTE:-

*1. DRAIN SHALL BE CONNECTED BY THE BIDDER TO THE NEAREST PLANT DRAIN THROUGH OPEN FUNNEL USING 2" CS PIPE FROM FUNNEL TO PLANT DRAIN.

**2. FOR AIR/FLUE GAS LIEs FOR DRAINING THE IMPULSE LINE BETWEEN ITEM 17 DRAIN POT TO BE PROVIDED ALONGWITH DRAIN HEADER, 3/4" SW HALF COUPLET, ITEM 19,20,22,23 & FUNNEL ALONGWITH 1/2" PIPING TO PLANT DRAIN HEADER SHALL BE PROVIDED FOR STM/WATER. ALL ITEMS EXCEPT DRAIN POT TO BE PROVIDED.

3. GI PIPES SHALL BE PROVIDED FOR PURGE AIR CONNECTION OUTSIDE LIE/LIR.

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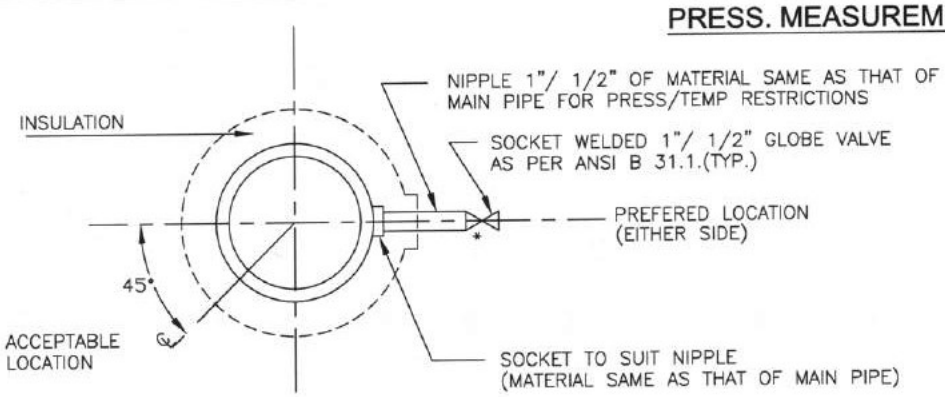
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.		P.S.C	02.05.14
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

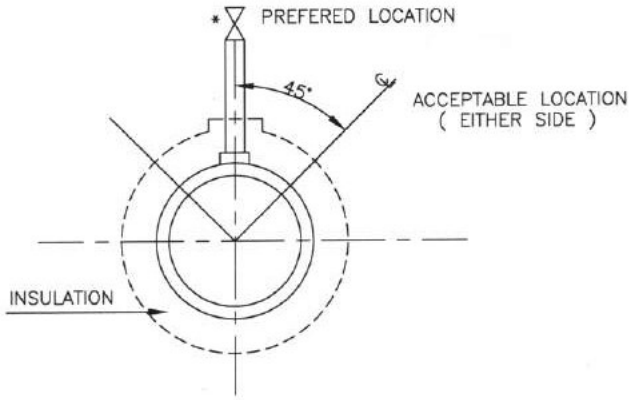
TITLE: INSTRUMENT INSTALLATION DIAGRAM
TYPICAL PURGE AIR CONNECTION & BLOWDOWN HEADER CONNECTION INSIDE INSTRUMENT RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-034	B

PRESS. MEASUREMENT

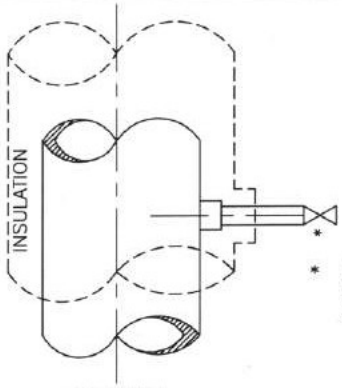


ELEVATION
LIQUID SERVICE



ELEVATION
STEAM SERVICE

PRESSURE CONNECTION ON HORIZONTAL PIPE



ELEVATION
LIQUID OR STEAM SERVICE

PRESSURE CONNECTIONS ON VERTICAL PIPES

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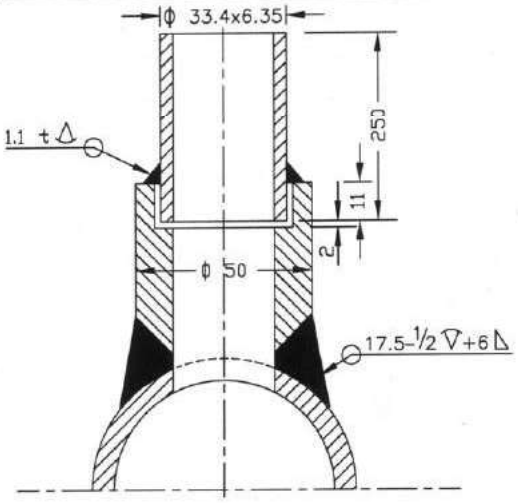
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.10

CLEARED BY

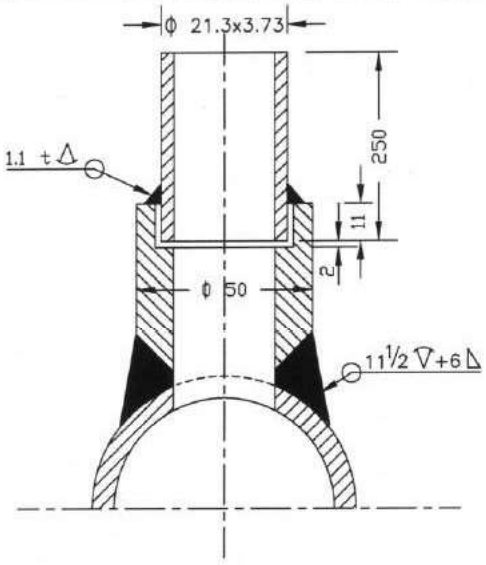
PROJECT	TYPICALTHERMAL POWER PROJECT			
TITLE	INSTRUMENT SOURCE CONNECTION DETAILS			
SIZE A4	SCALE N.T.S.	DRG. NO. 0000-999-POI-A-035 Sh-1 Of 14	REV. NO. A	

PRESSURE MEASUREMENT

(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



NOTES:–

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.12

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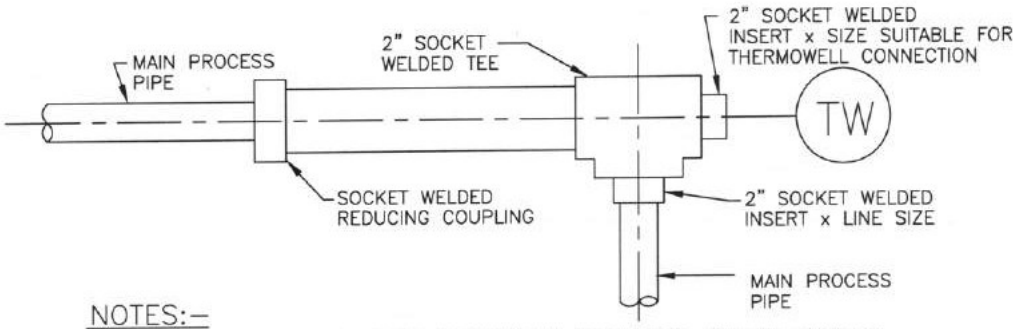
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

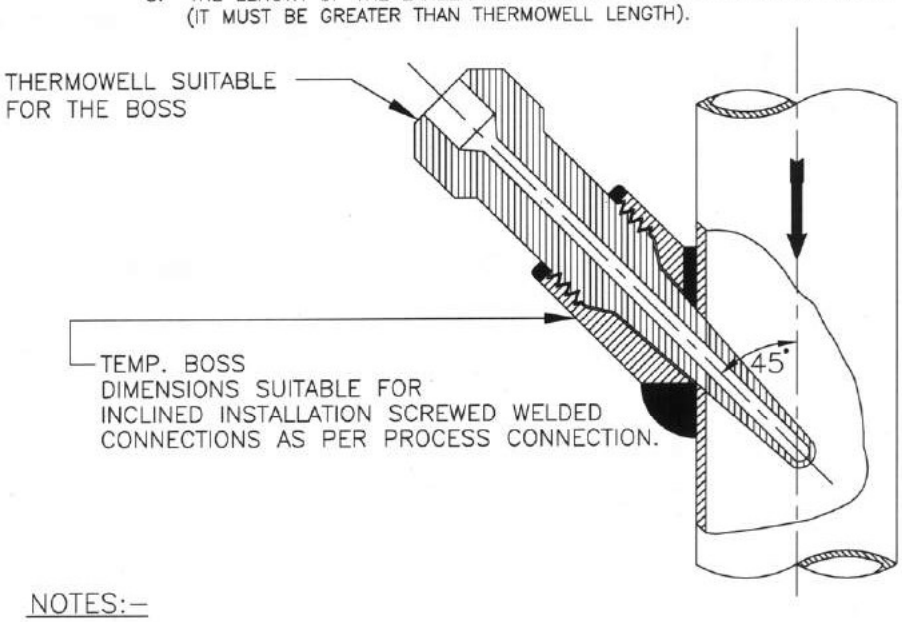
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-2 Of 14	A

TEMP. MEASUREMENT



NOTES:–

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).



NOTES:–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.13

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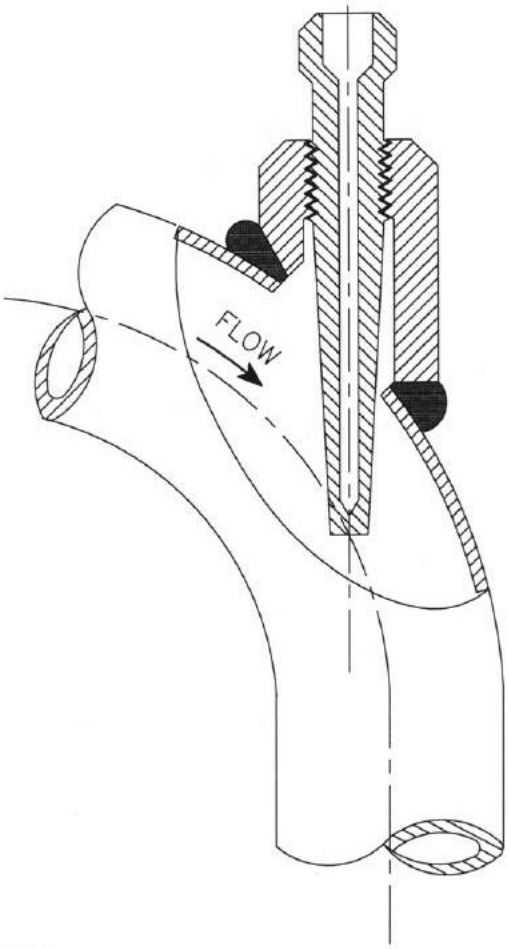
PROJECT	TYPICALTHERMAL POWER PROJECT (SG PACKAGE)			
TITLE	INSTRUMENT SOURCE CONNECTION DETAILS			
SIZE A4	SCALE N.T.S.	DRG. NO. 0000-999/102-POI-A-035 Sh–4 Of 14	REV. NO. A	

TEMP. MEASUREMENT



NOTES:–

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.13

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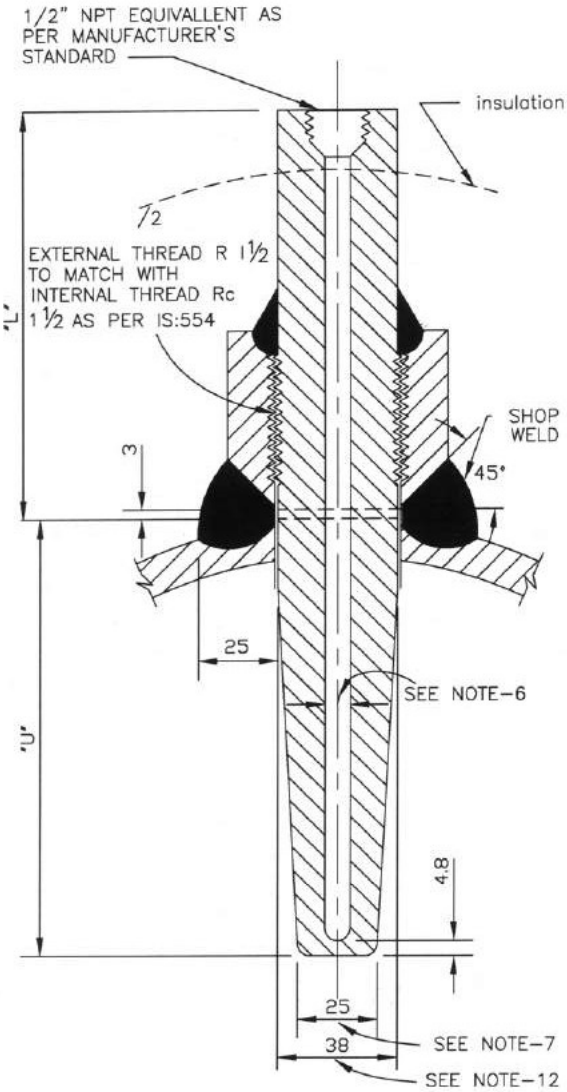
NTPC — N T P C LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-5 Of 14	A

TEMP. MEASUREMENT



NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ABOVE 40 Kg/Cm2(g).
2. THE MATERIAL OF THE BOSS SHOULD BE SIMILAR TO THAT OF PIPING MATERIAL OF SPECIFICATION.
3. ALL WELD TO BE TESTED IN ACCORDANCE WITH APPLICABLE CODES BY MANUFACTURER.
4. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
5. THERMOWELL SHALL BE DRILLED BARSTOCK TYPE.
6. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME,PTC-19.3.
7. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS.AND TEMP.,AS PER ASME,PTC-19.3.
8. THE TYPE OF TAPERED THERMOWELL SHALL BE USED FOR LIQUID VELOCITIES UP TO 92M.P.S.(300F.T.P.S.).
9. THERMOWELL WITH THE INSULATION LAG EXTENSIONS SHALL BE USED WHEREVER APPLICABLE.
10. ACTIVITIES TO BE COMPLETED AT THE SHOP. WELD THE BOSS ON THE PIPE AND DRILL THE HOLE IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE BOSS. PROVIDE INTERNAL THREAD AS PER IS:554 TO MATCH WITH THE THERMOWELL EXTERNAL THREAD.
11. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
12. WIILL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER RC 1½
13. THE "U" & "L" DIMENSIONS SHALL BE BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAILED ENGINEERING.
14. ALL DIMENSIONS ARE INDICATIVE ONLY.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE										21.06.12

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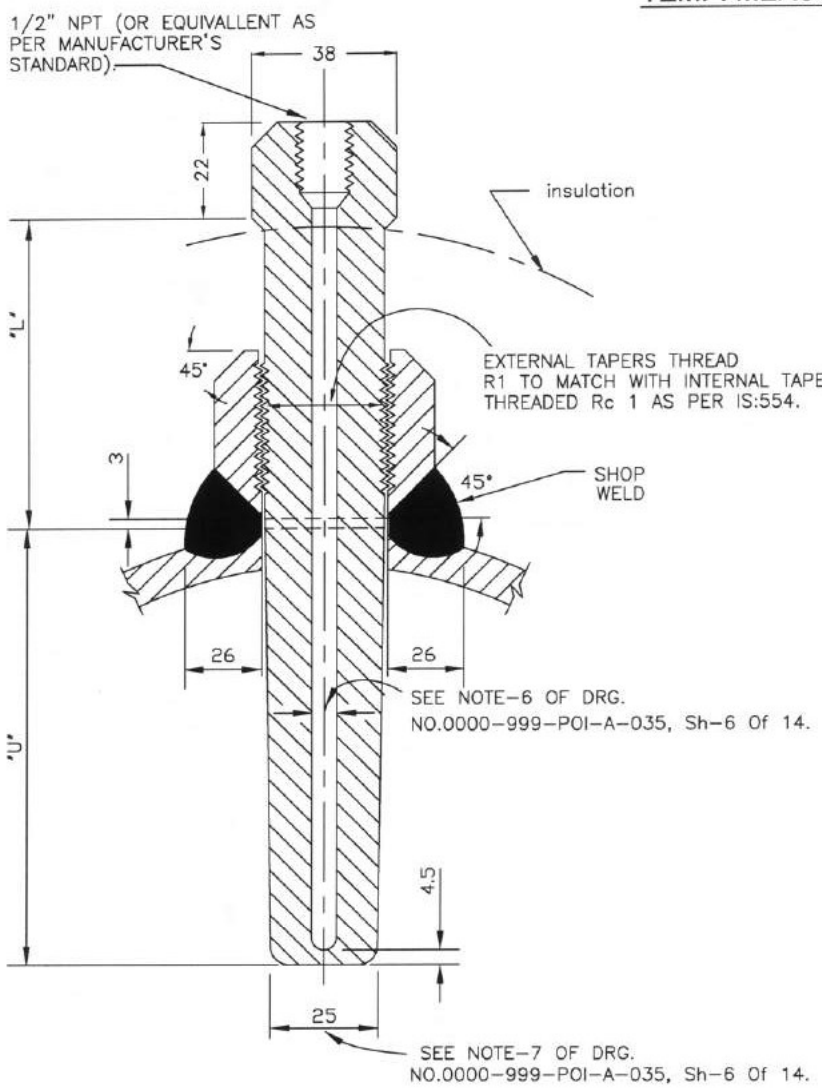
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-6 Of 14	A

TEMP. MEASUREMENT



NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm2(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

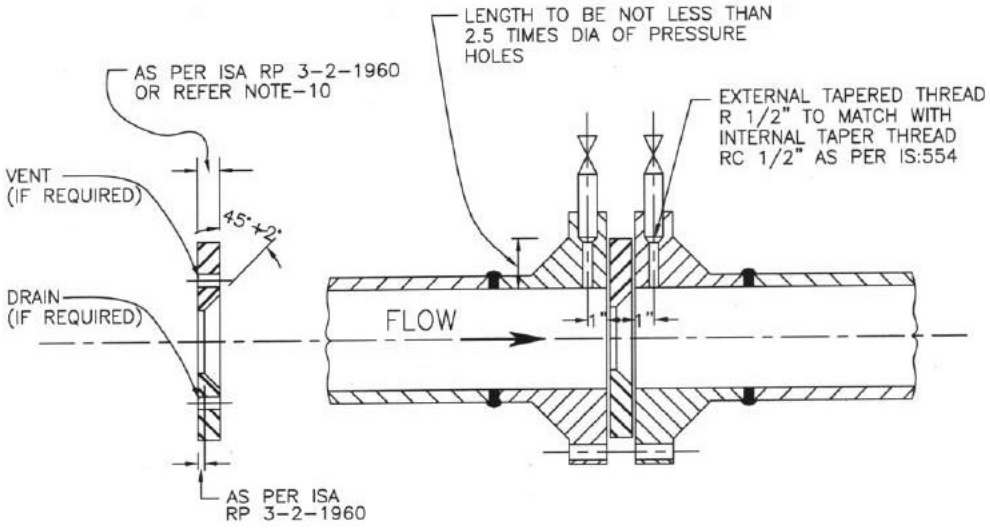
FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.13
					CLEARED BY						

NTPC — NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT	TYPICALTHERMAL POWER PROJECT			
TITLE	INSTRUMENT SOURCE CONNECTION DETAILS			
SIZE A4	SCALE N.T.S.	DRG. NO. 0000-999-POI-A-035 Sh-7 Of 14		REV. NO. A

FLOW MEASUREMENT



NOTES:-

1. ORIFICE PLATE MOUNTED BETWEEN FLANGES WITH FLANGE TAPPING (AS SHOWN ABOVE) SHOULD BE LIMITED TO PIPE SIZES OF 2" OR LARGER.
2. ORIFICE PLATE SHALL BE MOUNTED BETWEEN PIPING FLANGES WITH THE SHARP EDGE FACING UPSTREAM SUCH THAT CENTRE OF THE CONCENTRIC ORIFICE SHOULD BE WITHIN 0.79 mm (1/32") OF THE AXIS OF THE PIPE.
3. TWO GASKETS SHALL BE INSERTED BETWEEN THE PLATE AND THE FLANGES AND INSIDE DIAMETER OF THE GASKETS SHOULD BE ATLEAST 1.5 mm (1/16") GREATER THAN THE INSIDE DIAMETER OF THE PIPE SO THAT THEY DO NOT PROTRUDE INTO THE PIPE.
4. PIPING FLANGES SHALL BE ANSI WELD NECK, RAISED FACE TYPE. THE FLANGE IS TO BE ALIGNED WITH THE FACE PERPENDICULAR TO THE FLOW AXIS.
5. BIDDER TO SUPPLY ORIFICE PLATE SPECIAL TYPE (HAVING PRESS. CONNECTIONS) OF FLANGES ALONG WITH GASKETS, NIPPLES AND SOURCE VALVES.
6. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE TAKEN FROM SIDES FOR LIQUID AND STEAM SERVICE AND FROM TOP FOR DRY GAS SERVICE. FOR PROCESS LIQUIDS INSTALLATION OF PRESSURE TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW THE HORIZONTAL IN SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
7. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF THE DISTANCE SPECIFIED.
8. MAXIMUM DIAMETER OF PRESS. CONNECTION HOLES SHALL BE AS PER RECOMMENDATIONS OF ASME PTC 19.5. THE DIAMETER OF THE HOLE SHOULD REMAIN THE SAME FOR A DISTANCE NOT LESS THAN 2.5 TIMES OF THE DIAMETER BEFORE EXPANDING INTO THE PRESSURE PIPE.
9. THERE MUST BE NO BURRS WIRE EDGES OR OTHER IRREGULARTIES ALONG THE EDGE OF THE HOLE AND IT MUST BE SQUARE AND ROUNDED SLIGHTLY (1/64" RADIUS).
10. ORIFICE PLATE SHOULD BE FLAT WITHIN 0.02 mm (0.001") AND THE SURFACE ROUGHNESS SHOULD NOT EXCEED 20 MICRO INCH. THE THICKNESS OF THE ORIFICE PLATE SHOULD BE AS PER EN ISO 5167:2003.
11. FOR HORIZONTAL PIPE RUN DRAIN HOLES IN ORIFICE PLATES ARE AT THE BOTTOM (APPROX. TANGENT TO INSIDE DIA OF PIPE) FOR STEAM OR GAS SERVICE. VENT HOLES SHOULD BE LOCATED ON UPPER SIDE FOR INCOMPRESSIBLE FLUID.
12. ORIFICE PLATE SHOULD BE OF 316 SS (ASTM A167-54 GRADE-II).
13. RECOMMENDED MINIMUM LENGTHS OF STRAIGHT PIPE PRECEDING AND FOLLOWING ORIFICES SHALL BE AS PER EN ISO 5167:2003.
14. THREE PAIRS OF PRESSURE TAPS SHALL BE PROVIDED WITH NIPPLES OF REQUIRED LENGTH AND SOURCE VALVES AND THE UN-USED TAPS ARE PLUGGED.
15. THE INTERNAL TAPERED CONNECTION WITHIN THE FLANGE FOR PRESSURE TAPS SHOULD BE RC 1/2" AND THE NIPPLE SHOULD ALSO OF EXTERNAL THREADED R 1/2" AS PER IS:554. THE LENGTH OF THREADED ENGAGEMENT SHALL BE AS PER ABOVE STANDARD.

FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
					CLEARED BY						
A	FIRST ISSUE							T.G.			21.06.13

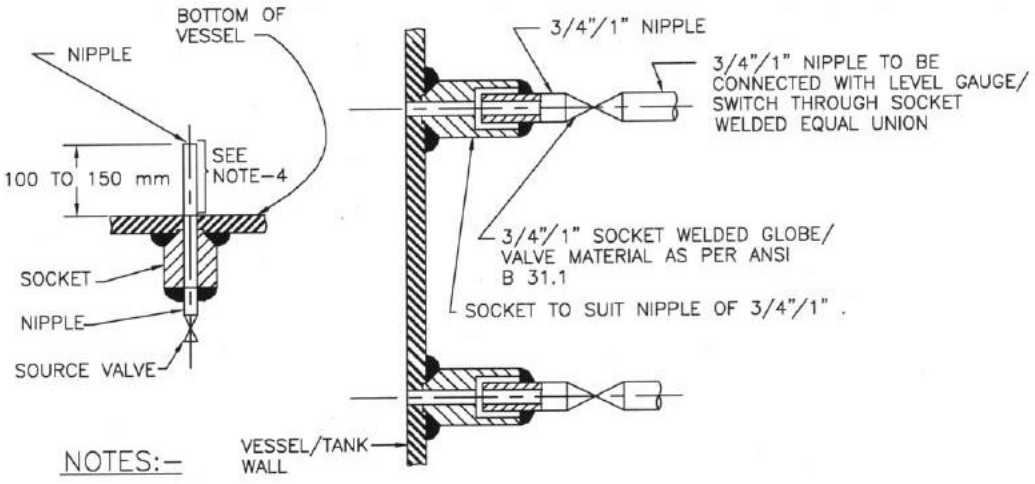
NTPC — NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

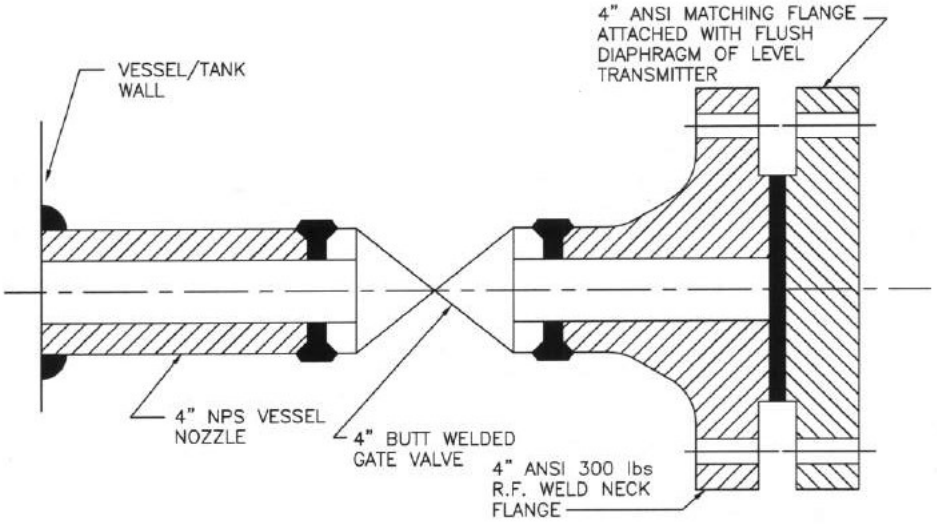
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-12 Of 14	A

LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

FOR TENDER PURPOSE ONLY

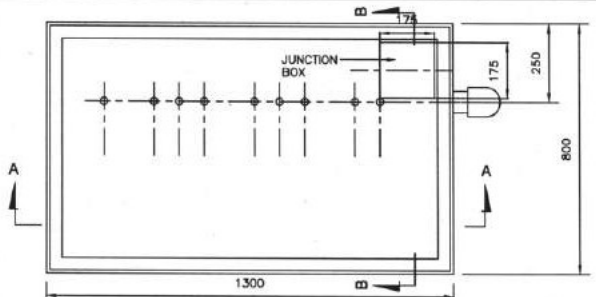
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			01.08.13
					CLEARED BY						

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

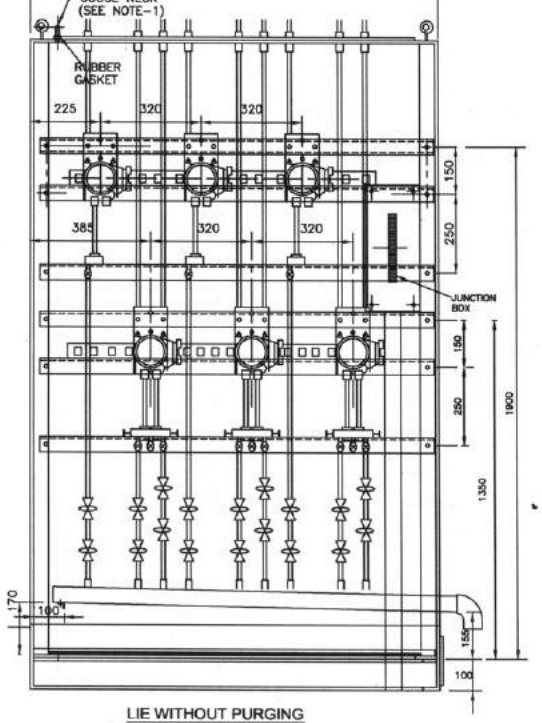
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

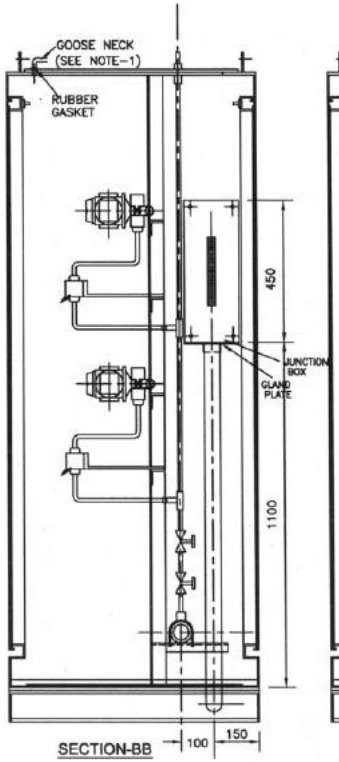
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-13 Of 14	A



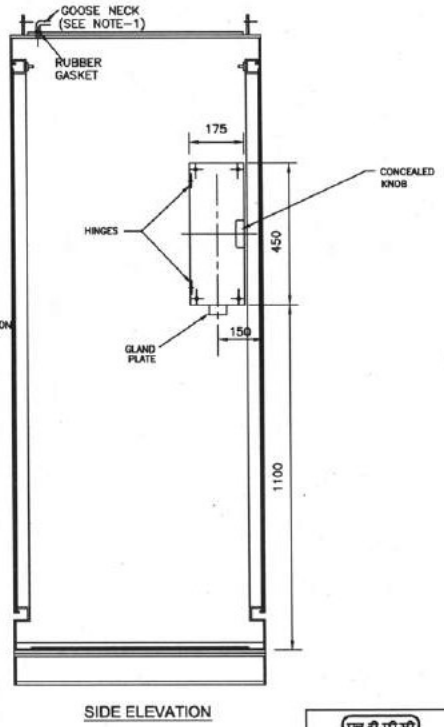
LIE TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	6	1250
B	4	930
C	2	630



LIE WITHOUT PURGING



SECTION-BB



SIDE ELEVATION

NOTES:-

1. TO BE PROVIDED FOR LIEs USED IN STEAM & WATER APPLICATION.
2. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

FOR TENDER PURPOSE ONLY

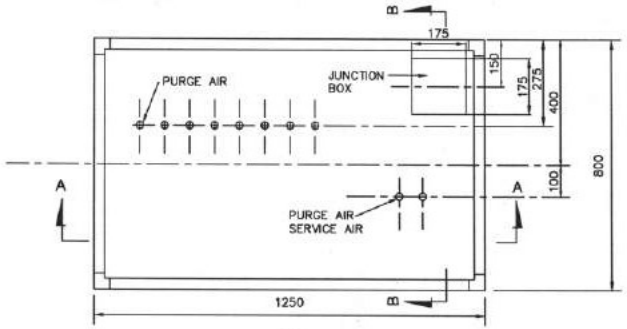
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.06.12
					CLEARED BY						

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

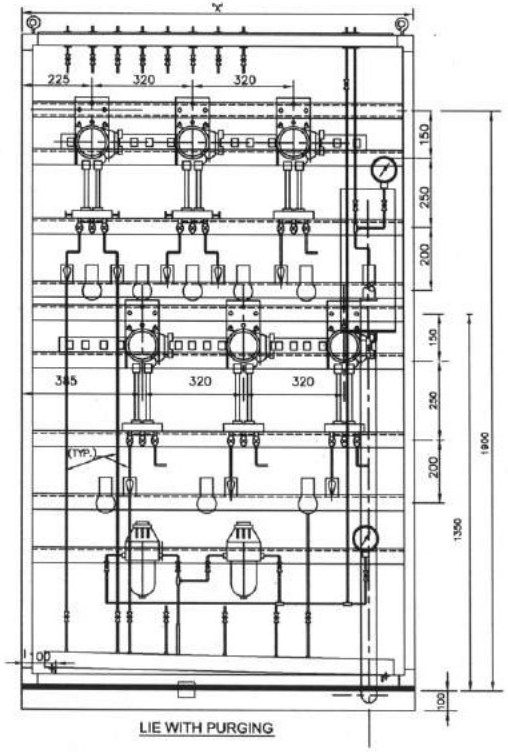
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

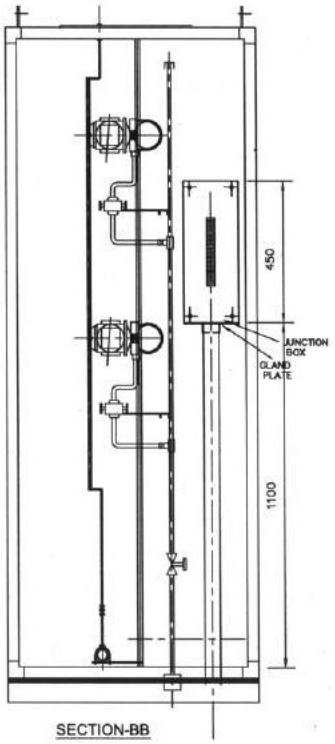
SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SHEET 01 OF 03	B



LIE TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	6	1300
B	4	980
C	2	680



LIE WITH PURGING



SECTION-BB

NOTES:-

1. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

FOR TENDER PURPOSE ONLY

NTPC LIMITED
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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE			T.G.							19.04.12

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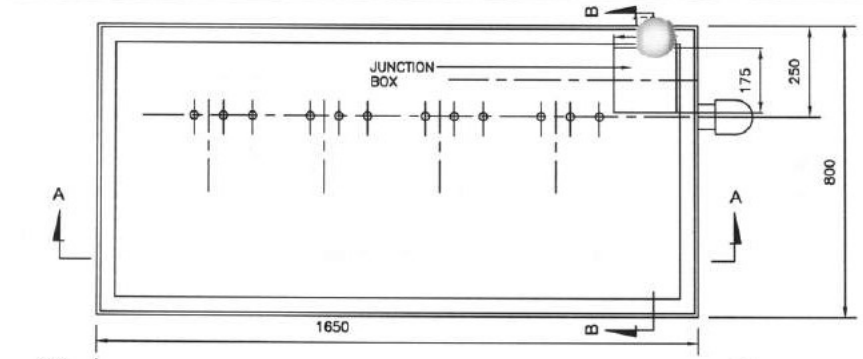
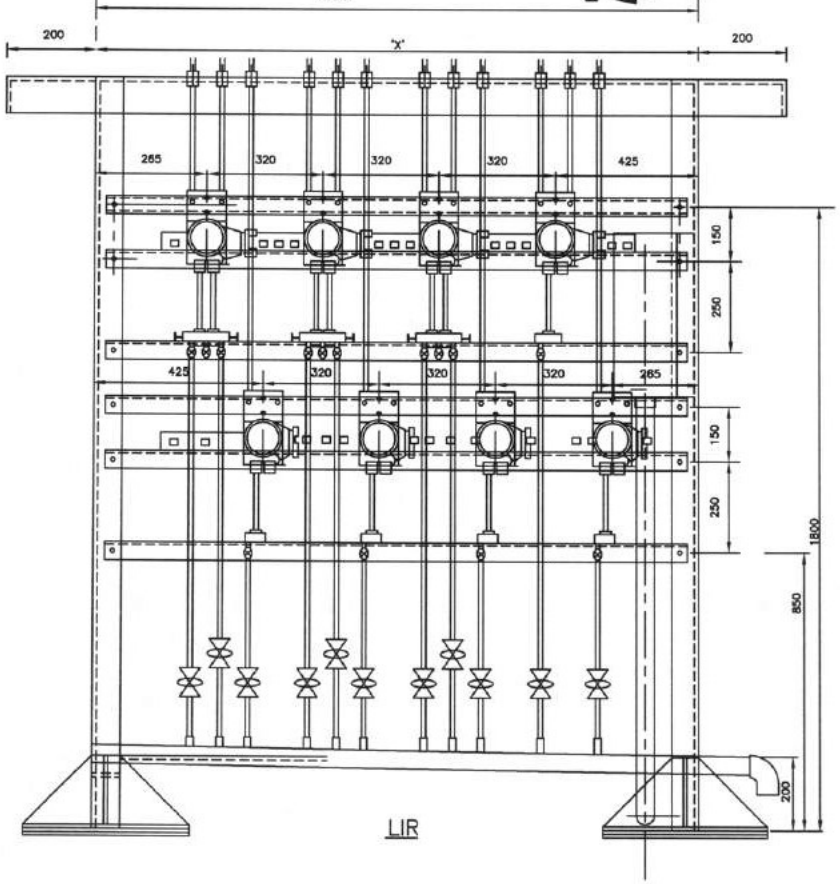
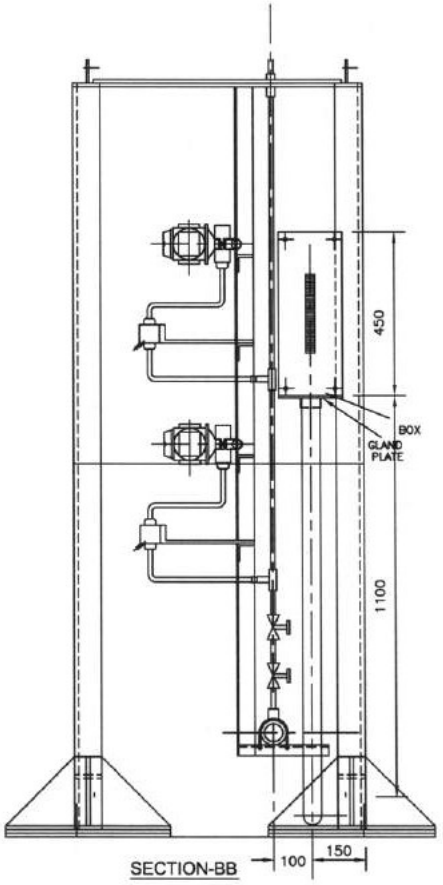
SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SH- 02 OF 03	B





LIR



SECTION-BB

100 150

LIR TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	8	1650
B	6	1330
C	4	1010

NOTE:-

1. MATERIAL OF JBs FOR LIRs SHALL BE SAME AS THAT OF LIR.

SECTION-AA
LIR WITHOUT PURGING

FOR TENDER PURPOSE ONLY

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY: M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-064 SH- 03 OF 03	A

SECTION-II

GENERAL TECHNICAL REQUIRMENT

SECTION- II A: GENERAL TECHNICAL REQUIRMENT-MECHANICAL
SECTION- II B: GENERAL TECHNICAL REQUIRMENT-ELECTRICAL
SECTION- IIC: GENERAL TECHNICAL REQUIRMENT-CONTROL & INSTRUMENTATION

SECTION-IIA

GENERALTECHNICAL REQUIRMENT - MECHANICAL

GENERALTECHNICAL REQUIRMENT - MECHANICAL FOR PROJECT

1.00.00 **INTRODUCTION**

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **NOT USED**

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a EPC Package contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following :

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m) Explosive Rules, 1983

(n) Petroleum Act, 1984

(o) Petroleum Rules, 1976,

(p) Gas Cylinder Rules, 1981

(q) Static and Mobile Pressure Vessels (Unified) Rules, 1981

(r) Workmen's Compensation Act, 1923

(s) Workmen's Compensation Rules, 1924

(t) NTPC Safety Rules for Construction and Erection

(u) NTPC Safety Policy

(v) CERC (Indian Electricity Grid Code) Regulations, 2023

(w) CEA (Flexible Operation of Coal Based Thermal Power Generating Units) Regulations, 2023

(x) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise in the specifications, the latest editions (as applicable at the date fifteen (15) days prior to the date of bid submission), of the codes and standards given below shall also apply:

a) Bureau of Indian standards (BIS)

b) Japanese Industrial Standards (JIS)

c) American National Standards Institute (ANSI)

d) American Society of Testing and Materials (ASTM)

e) American Society of Mechanical Engineers (ASME)

f) American Petroleum Institute (API)

g) Standards of the Hydraulic Institute, U.S.A.

h) International Organization for Standardization (ISO)

i) Tubular Exchanger Manufacturer's Association (TEMA)

j) American Welding Society (AWS)

k) National Electrical Manufacturers Association (NEMA)

l) National Fire Protection Association (NFPA)

m) International Electro-Technical Commission (IEC)/ European Norm (EN)

n) Expansion Joint Manufacturers Association (EJMA)

o) Heat Exchange Institute (HEI)

p) IEEE standard

q) JEC standard

5.03.00	Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.
5.04.00	As regards highly standardized equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
5.07.00	In case of any change in codes, standards & regulations between the date fifteen (15) days prior to the date of bid submission and the date when vendors proceed with fabrication and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.
6.00.00	**EQUIPMENT FUNCTIONAL GUARANTEE**
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **DESIGN OF FACILITIES**

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path, turbine & equipments, inspection of the steam path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is an **EPC Package contract**. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engineering and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimization studies including thermal cycle optimization.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Water Balance diagram.

viii) Operation Philosophy and the control philosophy of the Main Plant and other plants.

ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the station.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, Process and Instrumentation diagrams along with write up and system description.

iv) Start-up curves for boiler and both turbines and boiler combined together as a unit for various start-ups, viz. Cold, Warm and Hot start up.

v) Piping isometric, composite layout and fabrication drawings, design philosophy & design parameter selection for each piping system, Pressure drop calculation & flash tank sizing calculation.

vi) Piping engineering diagrams, pipe and fittings schedules, System-wise or P&ID wise prepared pipe schedule, valve schedule, insulation schedule, hanger and support schedule and Piping isometric / fabrication isometric drawings for pipe size 65mm NB and above with BOM, Painting schedule. Hanger / support arrangement drawing with BOM, Valve GA drawings, Layout drawings for site routed piping (i.e. for pipe sizes below 65NB) along with BOM (and submission of the same to the employer / project manager before start of work) and System wise stress analysis / dynamic analysis report (including input) along with stress isometric drawing / sketch marked with node points. Also As-Built drawing for information & Records: (i) Piping fabrication isometric drawing (ii) composite piping layout drawing (iii) Hanger / Support arrangement drawing.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like Mills, Fans, BFPs, CEPs, Heaters/ Deaerators, Water cooled Condensers, Vacuum pumps etc.

ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.

xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser, design ramp rates of SG and TG and heat exchanger thermal calculations etc.).

xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xiii) Comprehensive list of all Terminal Points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xv) Protection system diagrams and relay settings.

xvi) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report and power system stability study report.

xxii) Control system configuration diagrams and card circuit diagrams and maintenance details.

xxiii) Detailed DDCMIS system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling, sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

xxxii) BOP documents such as P&IDs, Sizing calculations for various equipment's, performance curves, datasheet etc. (For CHP, AHP, PU, Water System etc.) shall be as per MDL.

xxxiii) Bidder shall submit all tabulated design calculations/ data (e.g. Pipe schedule, valve schedule, etc.), in both EXCEL format as well as in PDF format to enable NTPC for fast review /approval.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of a particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tools, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (This to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expectancy & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the plant layouts shall be made in computerized 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary.

All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings and RCC layout of major buildings and structural arrangement drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through

animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer.

Observations of NTPC during the 3D model review to be incorporated and revised editable model to be submitted to NTPC within 2 weeks.

The complete 3D data (editable model) which shall be utilised for all future detailed engineering related to maintenance, operation, R&M, efficiency improvement of the project etc. Complete 3D model along with as built GADs, layout, isometrics, reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases.

All input files of software used for design of Equipments / Piping like CAESAR2 files, input files for Pressure vessel design, datasheets etc., shall be handed over to NTPC as per NTPC specifications for handover of Engineering Information.

Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time.

All software and hardware shall be supplied by bidder within 3 months of NOA. The 3D modelling software shall preferably be the same software bidder will be using for preparation of 3D model or it shall have all editable features to edit the model supplied by bidder on time to time basis.

All software provided shall necessarily include cost for perpetual license(s) for use on all the machines and an Annual maintenance contract (AMC) which shall include software upgrades as & when released by the software agency for a period of three years after warranty/guarantee period .

Handover Plan: There shall be continuous handover of documents and data at various stages of the project including rules and trigger points for handover of data to NTPC shall be at 30%, 60% and 90 % of 3D model stage.

Database backup shall be taken every month and handed over to NTPC.

b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission **in line with suggestive MDL**.

Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external

connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to

submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document as per Annexure-VI. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

8.03.05 **e-Learning Package:**

e-learning packages shall be supplied for the equipment / system for the following Steam Turbine Generator & auxiliaries and Steam Generator & auxiliaries along with associated electrical and C&I system.

8.03.05.01 Steam Turbine Generator & Auxiliaries

Steam Turbine including stop valves, control valves, overload valves and cross over piping. Steam Turbine Auxiliary Systems including Quick Closing and Ordinary NRVs, Turbine gland sealing system, Lubricating oil system and its purification system, Centralized oil storage and its purification system, Control fluid and its purification system, governing and protection system, exhaust hood spray cooling system, drainage and vent system, turbine preservation system, HP/LP Bypass system.

Generator and Auxiliary System including Generator, complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable, complete seal oil system, complete water cooling system where applicable and complete excitation system.

Condensing Plant including Condenser, Condenser air evacuation system and Condenser on load tube cleaning system as applicable etc.

Drip Pump along with all accessories as applicable, Condensate Extraction Pumps along with all accessories, Deaerator level Control Station, Feed Water Heating Plant including Drain Cooler, low pressure heaters, deaerator and feed storage tank, high pressure heaters and associated accessories, Boiler Feed Pumps along with all accessories, Drive Turbine for Boiler Feed Pump along with all accessories, Feed regulating station, Make up system to Condenser, Gland Steam Condenser Recirculation System, Turbine Hall EOT Cranes and EOT Crane for Boiler Feed Pump as applicable.

8.03.05.02 **Steam Generator & Auxiliaries**

Furnace/evaporator, separator & drain collection vessel, superheater, reheater, economiser, startup recirculation & drain system, desuperheating spray system, safety valves, soot blowing system, draft plant including FD & ID fans, PA fan, air preheaters, SCAPH, coal preparation and firing system including raw coal feeder and pulverisers, coal burners, fuel oil system and oil burners, Electrostatic precipitator, NOx control system and Flue gas desulphurisation system, Aux. PRDS system.

8.03.05.03 These packages shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI), NTPC located at Noida. The Project Manager / Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified above is to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system .

2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above.

a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.

b. The commissioning course(s) should include instructions on pre-commissioning, commissioning, initial operation etc.

c. The operation course(s) should include instructions on the permissive, interlocks, physical check-ups, start-up, shutdown and protections etc.

d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

Depth of coverage of above courses shall be as specified for **"Instruction Manuals"** in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of Project Manager / EIC or representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site.

The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.

4. e-Learning course broad requirements:

a. The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.

b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.

c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.

d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.

e. Each course shall have every physical and functional detail of the equipment / system supplied.

f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.

g. There shall be option for self-assessment test after every course. In case the user doesn't opt for self-assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.

h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.

i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.

j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.

k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.

l. The system shall provide the user with the ability to select the information with a Cursor.

m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop-up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.

n. Every course shall contain the 3D design/drawing/exploded view/360^0 turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio.

o. The users shall be able to control audio sound level associated with the courses.

p. Drawings / text in the courses shall be scalable (Zoom In/ Out).

q. The user shall have the capability to record a **bookmark** to mark displayed information for later recall, whenever he accesses the same course next time.

Notes:

1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.
3. The vendor shall get the approval of one sample course from Project Manager / EIC before proceeding for further courses.

8.04.00 Provision for Fail Safe operation of vital Equipments

All the Plant and equipments / Systems supplied under the contract shall be designed following “Fail Safe” concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves/dampers etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.

8.05.00 Engineering Co-ordination Procedure

8.05.01 The following principal coordinators will be identified by respective organizations after award of contract:

NTPC Engineering Coordinator (NTPC EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.05.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.05.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) Not used

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.

d) Not used

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) **Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.**

g) The Contractor shall submit drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within three (3) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories:

CATEGORY- I:	Approved
CATEGORY- II	Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.
CATEGORY –III	Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.
CATEGORY -IV	For information and records.

h) After Rev 0 comments, the drawing will be locked in the system. Contractor will review the Rev 0 comments within 7 days & furnish the Comment Reply Sheet (CRS) to NTPC as an agenda point for TCM. TCM shall be conducted with Contractor on non-agreed comments of CRS. System will not allow Contractor to submit approval category drawings before the scheduled submission date. However, documents may be unlocked on case to case basis. Based on resolution of all comments and agreements, the document will be approved in TCM itself. The contractor will revise the document based on the resolutions and certify that all the resolutions has been taken care of.

Based on this certification, the document will be opened and submitted by contractor in the system for approval as Rev 01 within 10 days of TCM.

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

8.06.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.06.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.06.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA /

	HYDERABAD / PROJECT SITE or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the comments of the Employer shall be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
9.02.02	Should any drawing remain unapproved for more than four (4) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.
10.00.00	**DESIGN IMPROVEMENTS** The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
11.00.00	**EQUIPMENT BASES** A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.
12.00.00	**PROTECTIVE GUARDS**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

13.01.00 All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H_2, CO_2 and N_2 for Generator) etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

Bidder scope shall include supply of H_2, CO_2 and N_2 as applicable for the Generator till successful commissioning of Generator.

Bidder shall supply a quantity not less than 10% of the full charge or one (1) year topping requirement mentioned above (Whichever is higher) of each variety of lubricants, servo fluids, gases etc. (as detailed above) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.

13.02.00 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. However, the lube oil for Main Turbine, Drive Turbine, TDBFP and MDBFP shall be kept same in view of ease of operation and maintenance.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.

14.00.00 **LUBRICATION**

14.01.00 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

15.00.00 **MATERIAL OF CONSTRUCTION**

15.01.00 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.

16.00.00	**RATING PLATES, NAME PLATES & LABELS**
16.01.00	Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.
16.03.00	Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non-pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm^2 (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 **WELDING**

18.01.00 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

19.00.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

19.01.00 All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

20.00.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

20.01.00 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a non-metallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be.

The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

20.02.00 **PRESERVATIVE SHOP COATING**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.

21.00.00 **QUALITY ASSURANCE PROGRAMME**

21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor’s works or at his sub-contractor’s premises or at the Employer’s site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be shall be finalized during detailed engineering with employer / authorized representative after discussion. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance

programme of the contractor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme

b) Quality System Manual

c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component. Format for the same is attached as Annexure VIII.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of

	inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalization of such quality plans shall be finalized during details engineering as per attached Annexure-VIII and format No. QS-01-QAI-P-1/F3. Monthly progress report shall be furnished.
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP, for review and approval.
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit

	the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.
22.07.00	No material shall be dispatched from the manufacturer's works before the same is accepted by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC / CHP Clearance).
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorized representative prior to carrying out the welding/brazing.
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. All welding / brazing procedures qualified / used at shop, will be made available to NTPC during audit / inspection. Procedures to be qualified at site will be submitted to NTPC.
22.11.00	Not Used.
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
22.14.00	No welding shall be carried out on cast iron components for repair.
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as

per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be Ultrasonically tested.

22.17.00 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI).

All the sub-vendors proposed by the Main contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format as Annexure-III.

List of NTPC approved sub vendors against similar Pkg/items is attached as Section-VI, Part-B ,Chapter E-60 Indicative sub-vendor list.

The contractor's proposal for any new sub vendor for any of the items identified in indicative sub-vendor list shall necessarily be furnished in the sub vendor questionnaire & main Contractor Evaluation report format attached as Annexure- VII with all relevant documents and main contractor's own physical assessment report assessed as per their quality management system for NTPC review and acceptance.

New sub vendor proposal will only be considered for NTPC review, provided the proposal is received sufficiently in time: 90 days prior to ordering date of a Bought-Out Items/Start of Manufacturing so as not to impede the progress of the contract.
Main contractor shall submit the documentation as mentioned below:

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i. Duly Filled Main supplier Evaluation Report.
ii. Duly Filled Sub-Supplier Questionnaire.
iii. Factory Registration Certificate.
iv. Overall Organization Chart with Manpower details (Design, Manufacturing, Quality etc.)
v. Supply reference list of the Sub-Supplier indicating similar product supply order reference no., customer name, rating of product, date /year of supply, date / year of commissioning.
vi. List of Manufacturing Equipment available with sub vendor.
vii. List of Testing Equipment available with sub vendor.
viii. Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any.
ix. Details of Outsourced Manufacturing Processes, if any.
x. Quality control exercised during receipt, in-process & final inspection.
xi. Compliance of Statutory requirements (As applicable)

After first submission of proposal to NTPC, in absence of relevant documents/ Incompleteness of the proposal, The main contractor will be given a period of maximum 07 days to submit the compliance of the NTPC comments. In case of noncompliance, it will be presumed that main contractor is not serious about pursuing the proposal & the proposal will be foreclosed.

Major checks and quality requirements as mentioned below shall necessarily be assessed by main contractor and complied with documentary support in case the same is not the part of their Quality management system

The proposed Sub vendor will be assessed broadly on following mandatory criteria

i) Quality Management System Compliance including raw material/BOI control, traceability & control over outsources process
ii) Design Capabilities (As applicable)
iii) Manufacturing, Testing & Storage Facility
iv) Processing Capabilities
v) Supply Experience indicating similar product supply order reference no., customer name, rating of product, date /year of supply, date / year of commissioning
vi) Safety Aspect

In case of major observations or non-compliance observed during sub vendor works visit (Jointly with the main contractor) with respect to the submitted documents, proposed sub vendor will not be considered for acceptance and Main contractor will be solely responsible in such cases.

Monthly progress reports on sub-vendor detail. Submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

22.18.00 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within two (2) weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.

22.19.00 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary

	assistance to enable the Employer carry out such audit and surveillance.
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his subcontractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
22.24.00	**Environmental Stress Screening** Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be furnished for NTPC acceptance
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.
22.26.00	**Software Reliability / Quality Certification** Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.

23.00.00	**QUALITY ASSURANCE DOCUMENTS**
23.01.00	The Contractor shall be required to submit the QA Documentation in soft copies, as identified in respective quality plan with tick (✓)mark.
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However, **soft copies will be furnished** not later than two (2) weeks.
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC
23.03.00	Similarly, the contractor shall be required to submit soft copies containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.
23.04.00	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased

deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than two (2) weeks after the despatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than two (2) weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Settlement of Disputes' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc.

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract

(d.) Inspect, accept or reject any equipment, material and work under the contract

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

25.01.00 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

25.02.00 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

25.03.00 The Contractor shall give the Project Manager/Inspector (15 days for domestic) / (45

	days for foreign) written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within (15 days for domestic) / (45 days for foreign) of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
25.04.00	The Project Manager or Inspector shall within 15 days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
25.05.00	When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Failure on the part of Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no. 25.03.00 - of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be

made for each three consecutive months and shall be furnished before beginning of each calendar month.

25.09.00 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

25.10.00 **ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME**

25.10.01 List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).**

25.10.02 Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.**

25.10.03 Field Welding Schedule Format enclosed at **Annexure-V.**

25.10.04 Main contractor evaluation report (MCER) and Sub vendor Questionnaire enclosed at **Annexure VII.**

25.10.05 QA&I modalities and QA Co-ordination procedure (QACP) enclosed at **Annexure-VIII.**

25.11.00 **TESTING OF MAJOR DESIGN FEATURES:**

The major design features of the system shall be demonstrated by the Contractor at the Contractor's works, or any other place mutually agreed within Six months from the date of Sub-QR/Provenness approval. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the Sub-QR/Provenness proposal, which shall be finalized during discussions with the bidder. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall also be tested during these major design tests. This shall include but not be limited to the following.

a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B.

b) Loop reaction time for sample loops/ logics.

c) SOE functionality tests.

d) Server changeover.

e) Various response times, having serious implication on operation & maintenance philosophy.

f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load.

g) Connectivity of Switchgear DDCMIS with Switchgear Relay Network.

The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer.

If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.

25.12.00 **DEMONSTRATION OF APPLICATION ENGINEERING**

25.12.01 Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.

(i) Logics/Loops:

a) Drive logics implementation for each type of binary drive along with its display in HMI.

b) Sequence implementation along with its display in HMI.

c) Single non-cascade controller implementation.

d) Cascade loop implementation.

e) Master slave implementation with different slave combination.

f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.

(ii) HMI Functions:

a) LVS Annunciation.

b) Graphics.

c) HSR

d) Logs/Reports.

e) Calculations (Basic & Performance Calculations).

25.12.02 The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

25.12.03 During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

26.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures

to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer.

(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.01.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain:

(1.) Biodata including experience of the Commissioning Engineers.
(2.) Role and responsibilities of the Commissioning Organisation members.
(3.) Expected duration of posting of the above Commissioning Engineers at site.

26.02.00 **Initial Operation**

(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the contractor shall conduct the trial run as per clause 26.05.00 to demonstrate the compliance to the requirements as stipulated in the CERC (Indian Electricity Grid Code) Regulations, 2023.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

(c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. To conduct such tests, the contractor's Commissioning, start-up Engineer shall make the unit ready (including tuning and all other enabling activities as required for PG tests) before start of initial operation. Such test shall be conducted along with the Initial Operations.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.

26.04.00 Before start of commissioning of critical equipment, Commissioning Clearance Certificate (CCC) to be submitted by Main contractor. List of the critical equipments **and CCC format will be provided along with QA Coordination procedure.**

26.05.00 Trial Run:

Trial run shall be conducted during the initial operation of the unit(s). Definition and provisions related to "trial run" shall be governed by CERC (Indian Electricity Grid Code) Regulations, 2023.

a. Contractor shall demonstrate the following as per the requirements of CERC (Indian Electricity Grid Code) Regulations, 2023:

i) Operation at a load of fifty-five (55) percent of MCR as per the CEA Technical Standards for Construction for a sustained period of four (4) hours.

ii) Ramp-up from fifty-five (55) percent of MCR to MCR at a ramp rate of at least one (1) percent of MCR per minute, in one step or two steps (with stabilization period of 30 minutes between two steps), and sustained operation at MCR for one (1) hour.

iii) Demonstrate overload capability with the valve wide open as per the CEA Technical Standards for Construction and sustained operation at that level for atleast five (5) minutes.

iv) Ramp-down from MCR to fifty-five (55) percent of MCR at a ramp rate of at least one (1) percent of MCR per minute, in one or two steps (with stabilization period of 30 minutes between two steps).

v) Primary response through injecting a frequency test signal with a step change of ± 0.1 Hz at 55%, 60%, 75% and 100% load. Provision of injecting external frequency test signal in control system for primary frequency response testing shall be in the contractor's scope.

vi) Reactive power capability as per the generator capability curve as provided by OEM considering over-excitation and under-excitation limiter settings and prevailing grid condition. These are the minimum test to be carried out as per the Indian Electricity Grid Code Regulations, 2023. Any other relevant clauses related to system performance or tests specified elsewhere in the specifications shall also be applicable.

b. The contractor shall demonstrate the continuous operation capability of the Unit(s) at MCR as per regulations 22 of CERC (Indian Electricity Grid Code) Regulations, 2023.

26.07.00 'Date of Commercial Operation' or 'COD' shall have the same meaning as specified under regulation 27 of Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations 2023, as amended from time to time.

27.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 TRAINING OF EMPLOYER'S PERSONNEL

28.01.00

The scope of service under training of Employer's engineers shall include a training module covering the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer:

(a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments.

(b) Training for Electric Systems including VFD and Electric power supply system.

(c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc. system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc.

c1: Training on Engineering, Model building,pre-testing, Post -test fine tuning of Advance process control systems with faculty having experience of atleast 5 years in Model Process Control.

(d) Training for special packages specified elsewhere in Technical Specification, Section-VI.

(e) Training for various C&I systems/equipment supplied includes the following:

i) DDCMIS - Human Machine Interface – Hardware & Operating System

ii) DDCMIS-Human Machine Interface System Engineering & Application Software.

iii) DDCMIS – Control System Hardware and Control system Application Software.

iv) DDCMIS – Operator Training : Use of the system at Works + at site.

v) DDCMIS – Specialized Network security.

(f) Training for power cycle piping/critical piping.

(g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system.

(h) Training on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis.

(i) Training on Non-Intrusive hardwired Electric Actuator and Fieldbus based Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator

(k) Training for numerical relays & networking systems supplied under MV & LT switchgear system.

(l) Training courses on offered PLC system in the following areas:

(a.) Operator training

(b.) Hardware Maintenance training

(c.) Software training

(d.) Any other specialized training as required for system operation and maintenance.

(m) Training for Ash Handling System & Coal Handling Plant Equipment and Auxiliaries

Area	Topics	Mandays
Ash Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ash handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Ash handling plant Visit to Manufacturer's Work - Manufacturing process of Ash handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	300
Coal Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Coal handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Coal handling plant Visit to Manufacturer's Work	150

	- Manufacturing process of Coal handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	

n) Training for UF Membranes, RO membranes, Zero Liquid Discharge (ZLD) Chlorine Di-Oxide (ClO_2) generation & dosing system, Condensate Polishing Plant (CPU) and CW Treatment System.

Area	Topics	MANDAYS
UF Membranes	**Product design** -Basic design features -Theory & principle of operation -Latest technological trends in Ultrafiltration membranes and design -CIP & CEB of UF system **Plant Visit** -Operational feedback -O&M history/problems related to UF membranes **Visit to Manufacturer's Work** -Manufacturing process of UF membranes and equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**7**

Area	Topics	MANDAYS
RO membranes	**Product design**	**7**

	-Basic design features -Theory & principle of operation -Latest technological trends in RO membranes and design -Failure analysis, types of failures, causes & its evaluation, remedies -CIP of RO system **Plant Visit** -Operational feedback -O&M history/problems related to RO membranes **Visit to Manufacturer's Work** -Manufacturing process of RO membranes and equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	
Zero Liquid Discharge (ZLD)	**System Design** - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant **Plant Visit** - Operational feedback - O&M history/problems related to plant	**5**
Chlorine Di-Oxide (ClO_2) generation & dosing system	**System/Product Design** - Basic design features - Theory & principle of operation - Latest technological trends in Chlorine Di-Oxide (ClO2) generation & dosing system and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history/ problems related to ClO2 plant	**5**

	Performance Test of generator - Generator capacity performance testing. **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	
Condensate Polishing Plant (CPU)	**System/Product Design** - Basic design features including Pre-filters - Theory & principle of operation - Latest technological trends in CPU & Pre-filters and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history / problems related to CPU plant **Visit to Manufacturer's Work** -Manufacturing process of pre-filters and major equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**3**
CW Treatment System	**System/Product Design** - Basic design features - Theory & principle of operation - Latest technological trends and design aspects & Selection criteria. **Operation & Maintenance of Plant** - Operational feedback - O&M history / problems related to plant - Trouble shooting and fault analysis Familiarization of special maintenance techniques - Special tool and tackles familiarization	**3**

Note: One week shall constitute of five (5) man days.

(o) Training for Electrical System

Area	Topics	MANDAYS
Generator	Product design -Design aspects of associated auxiliary systems - Familiarisation with cooling medium and arrangements, winding and core support systems Plant Visit -Operational feedback -O&M history/problems related to Insulation system Visit to Manufacturer's Work -Manufacturing process of core, winding bars, Assembly -Testing facilities Operation & Maintenance (Site) -Trouble shooting and fault analysis - Storage and Familiarization of special maintenance techniques -Special tool and tackles familiarization	60 (15+15+30)

Excitation systems including AVR	System Design - Design features of various sub systems, Exciter PMG - Excitation transformers, Controllers and different limiters - PSS and associated system studies Plant Visit - Operational feedback - O&M history/problems related to Excitation systems - Familiarization with various equipment functioning at reference plant Visit to Manufacturer's Work -Manufacturing process for various equipment of excitation systems -Testing facilities Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization Performance Test of generator - Generator capacity performance testing.	60 (15+15+30)
MV VFD (If applicable)	System/Product Design - Basic design features - Theory & principle of operation Plant Visit - Operational feedback - O&M history/ problems related to VFD - Familiarization with various equipment functioning at reference plant Operation & Maintenance (At Site) -Trouble shooting and fault analysis - Familiarization of special maintenance techniques -Special tool and tackles familiarization	90(15+15+60)
MV and LT switchgear	System/Product Design - Basic design features. - Relay configurations and hands on practices of logics and settings preparation - Preparation of CID/ICD/SCD files through	150 (45+15+90).

	relay software tools and Goose configurations. - Interfacing/communication of relay with software. - Secondary injection testing of protection functions. - Familiarisation of IMCC and Interface with DCS Plant Visit - Operational feedback - O&M history / problems Visit to Manufacturer's Work -Manufacturing process of equipment -Testing facilities Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of Switchgear, IMCC and interface with DCS, relays and interfacing software. -Special tool and tackles familiarization	
MDBFP, CW and BMCP Motors	System/Product Design - Basic design features of stator core and rotor core, winding insulation and cooling arrangements - Theory & principle of operation - Study of forces and Vibration. - Diagnostic and testing Plant Visit - Operational feedback - O&M history / problems Visit to Manufacturer's Work -Manufacturing process of equipment -Testing facilities Operation & Maintenance (At site) - O&M practices Familiarization of special maintenance techniques - Special tool and tackles familiarization	45 (15+15+15)

Relays and Substation Automation System	System/Product Design - Basic design features. - Relay configurations and hands on practices of logics and settings preparation - Preparation of CID/ICD/SCD files through relay software tools and Goose configurations. - Interfacing/communication of relay with software. - Secondary injection/ Sampled value testing of protection functions. - Familiarisation of SAS and Cyber security Features. Plant Visit - Operational feedback - O&M history / problems Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of relay configuration, settings and interfacing software. -Familiarization of SAS Hardware, software and Application software. - Secondary injection/ Sampled value testing of protection functions. - Familiarisation of cyber security features	75 (30+15+30)
AIS and bay equipment's	Operation & Maintenance (At site) -Erection, Storage and handling of bay equipment -Familiarization of special maintenance techniques -Special tool and tackles familiarization	30 (0+15+15)
Note: One week shall constitute of five (5) man days.		

(p) Training on Erection methodologies for all the Sub-packages, System and Equipments associated with the EPC Package, including a visit to power plant construction site.

The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval.

28.03.00	The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.
28.04.00	Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.
28.05.00	Contractor shall provide training on application of PAUT (Phased array ultrasonic testing) and TOFD (Time of flight diffraction) techniques for two weeks (at least 80 Hours). The training shall be arranged at least six months prior to the start of erection works of SG & TG works.
28.06.00	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.
28.07.00	In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.
28.08.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. **Note**: 1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person. 2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage. 3. Duration of each module shall not be less than 10 (ten) working days out of which 20 % shall be for plant/manufacturers' works visits and 80% shall be classroom training. 4. A) Location of classroom training for engineering shall be at Design/Engineering office. B) Classroom training for erection/O&M shall be at location of Manufacturers' works.

28.09.00 **TRAINING REQUIRED IN MAN MONTH**

Area	Engineering (Man months)	Erection (Man months)	O&M (Man months)
Steam Turbine Generator and its Auxiliaries	5.5	8.0	21
Steam Generator and its Auxiliaries	5.5	8.0	20.5
Station C&I (Control and Instrumentation)	3.5	5.5	10
Ash Handling Plant	2.0	3.0	5.0
Coal Handling Plant	1.0	1.5	2.5
UF Membranes, RO Membranes, ZLD, Chlorine Di Oxide (ClO2) generation & dosing system, Condensate Polishing Plant (CPU), CW Treatment System	0.2	0.3	0.5
Electrical systems consisting of generators, Excitation systems, VFD, Motors, MV/LV switchgears, relays, SAS and Switchyard	4.5	3.5	9
Total	**22.2**	**29.8**	**68.5**

29.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

i) Working platforms should be fenced and shall have means of access.

ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA.

ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA.

iii) Mill noise which will be limited to 85-90 dBA.

iv) TG unit in which case it shall not exceed 90 dBA.

v) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 90 dBA.

vi) For BFP Motor Noise level shall be within the limit of 90 dBA.

31.00.00 **PACKAGING, TRANSPORTATION AND STORAGE**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage at site due to improper packing and presevation. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

In addition to above, the contractor shall take all necessary measures for storage of all electronic equipment / systems at site in a dust free Air conditioned space ensuring proper temperature & humidity.

32.00.00 **ELECTRICAL EQUIPMENTS/ENCLOSURES**

32.01.00 All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

33.00.00 **INSTRUMENTATION AND CONTROL**

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

1 Temperature	-	Degree centigrade (deg C)
2. Pressure	-	Kilograms per square centimetre (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
3. Draught	-	Millimetres of water column (mm wc).
4. Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
5. Flow (Gas)	-	Tonnes/ hour
6. Flow (Steam)	-	Tonnes/ hour
7. Flow (Liquid)	-	Tonnes / hour
8. Flow base	-	760 mm Hg. 15 deg.C
9. Density	-	Grams per cubic centimetre.

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

35.00.00 **SURGE PROTECTION FOR SOLID STATE EQUIPMENT**

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.

36.00.00 **INSTRUMENT AIR SYSTEM**

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.00.00 **TAPPING POINTS FOR MEASUREMENTS**

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

i) Temperature test pockets with stub and thermowell

ii) Pressure test pockets

38.00.00 **SYSTEM DOCUMENTATION**

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

39.00.00 **MAINTENANCE MANUALS OF ELECTRONIC MODULES**

The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc. as required to do the testing and maintenance of the electronic modules.

Backup & Restoration Procedures of DDCMIS, Station LAN & Advance Process Control shall be provided.

40.00.00 **MAKE IN INDIA REQUIREMENTS**

a) The bidder shall follow Indian laws, regulations and standards. There shall not be any restriction in terms of compliance to codes & standards of foreign origin only. The compliance to equivalent/better Indian as well as other codes & standards, wherever available, shall also be acceptable.

b)	The technologies/ products offered shall be environmentally friendly, consuming less energy, and safe, energy efficient, durable and long lasting under the prescribed operational conditions.
c)	The bidder/its sub vendor/supplier shall ensure supply of spares, materials and technological support for the entire life of the project.
d)	The bidder shall list out the products and components producing Toxic E-waste and other waste as specified. It shall have an Extended Producers Responsibility (EPR) so that after the completion of the lifecycle, the materials are safely recycled/ disposed of by the contractor and for this, the bidder has to establish recycling/disposal unit as specified. Bidder shall also comply with Plastic Waste Management Rules, 2016, as amended from time to time, and facilitate EPR (Extended Producer Responsibility) registration of Employer before import of plastic packaging product or products with plastic packaging or carry bags or multi-layered packaging or plastic sheets or like.
e)	The equipment/ material sourced from foreign companies will be tested in accredited labs in India before acceptance wherever such facilities are available. The testing shall be carried out in accordance with MOP extant order/guidelines.
f)	The bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/process to be supplied/services to be rendered as safe to connect.
g)	All applicable safety requirements shall be met. Regular safety audit shall be carried out by the manufacturer/ supplier.
h)	Wherever required, the foreign supplier shall establish fully functional service centers in India and shall keep spares/material locally for future needs of Employer.
i)	To protect the security, integrity and reliability of equipment in this package, it is essential to remove vulnerabilities arising out of the possibility of cyber-attack through malware/ Trojans etc. embedded in imported equipments. This requirement shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in this package. Contractor shall comply all the requirements of Order No 25-11/6/2018-PG, dated 02/07/2020 (attached as **Appendix-I**), issued by Ministry of Power, Government of India and its subsequent amendments/revisions. Contractor shall furnish declaration of compliance of MOP order dated 02/07/2020 requirements with dispatch of equipment/ item. Further, Contractor shall furnish back up testing certificates, whenever Employer asks the same.
j)	All equipment/materials/parts/items required in this package which are domestically manufactured with sufficient domestic capacity as identified in Annexure-I of MOP order dated 16/11/2021 including its subsequent revisions (copy attached as **Appendix-II**) shall necessarily be sourced from the class-I local suppliers only as per the extant provisions of the Public Procurement (Preference to Make in India) Orders issued by DPIIT and MoP.

Any violation w.r.t Make in India and minimum local content (MLC) requirements as specified shall be sole responsibility of the Bidder.

Appendix-I

No.25-11/6/2018-PG
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi – 110001
Tele Fax: 011-23730264
*****

Dated 02/07/2020

ORDER

Power Supply System is a sensitive and critical infrastructure that supports not only our **national defence**, **vital emergency services** including health, disaster response, **critical national infrastructure** including classified data & communication services, defence installations and manufacturing establishments, logistics services but also the **entire economy** and the **day-to-day life** of the citizens of the country. Any danger or threat to Power Supply System can have catastrophic effects and has the potential to cripple the entire country. Therefore, the Power Sector is **a strategic and critical sector.**

The vulnerabilities in the Power Supply System & Network mainly arise out of the possibilities of cyber attacks through malware / Trojans etc. embedded in imported equipment. Hence, **to protect the security, integrity and reliability of the strategically important and critical Power Supply System & Network** in the country, the following directions are hereby issued :-

(1) All equipment, components, and parts imported for use in the Power Supply System and Network shall be tested in the country to check for any kind of embedded malware/trojans/cyber threat and for adherence to Indian Standards.

(2) All such testings shall be done in certified laboratories that will be designated by the Ministry of Power (MoP).

(3) Any import of equipment/components/parts from "prior reference" countries as specified or by persons owned by, controlled by, or subject to the jurisdiction or the directions of these "prior reference" countries will require prior permission of the Government of India

(4) Where the equipment/components/parts are imported from "prior reference" countries, with special permission, the protocol for testing in certified and designated laboratories shall be approved by the Ministry of Power (MoP).

This order shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in power supply system or any activity directly or indirectly related to power supply system.

This issues with the approval of Hon'ble Minister of State for Power and New & Renewable Energy (Independent Charge).

(Goutam Ghosh)
Director
Tel: 011-23716674

To:
1. All Ministries/Departments of Government of India (As per list)
2. Secretary (Coordination),Cabinet Secretariat
3. Vice Chairman, NITI Aayog
4. Comptroller and Auditor General of India
5. Chairperson, CEA
6. CMDs of CPSEs/Chairman of DVC & BBMB/MD, EESL/DG,NPTI/DG,CPRI/DG,BEE/
7. All ASs/JSs/EA, MoP

Copy:
1. PS to Hon'ble PM, Prime Minister's Office
2. PS to Hon'ble MOS(IC) for Power and NRE
3. Sr. PPS to Secretary(Power)

Appendix-II

No. A-1/2021-FSC-Part(5)
Government of India
Ministry of Power
Shram Shakti Bhawan, New Delhi
Dated: 16th November, 2021

ORDER

Subject: Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Power Sector.

Reference: Department for Promotion of Industry and Internal Trade (DPIIT) Notification No. P-45021/2/2017-PP (BE-II) dated 16.09.2020.

The Government of India, Department for Promotion of Industry and Internal Trade (DPIIT) issued Public Procurement (Preference to Make in India), Order 2017, for encouraging 'Make in India' and promoting manufacturing and production of goods and services in India with a view to enhancing income and employment. Subsequently, DPIIT vide order No. P-45021/2/2017-PP (BE-II) dated 4th June, 2020 and further vide order dated 16th September, 2020 have issued the revised Public Procurement (Preference to Make in India) Order 2017.

2. In light of the Public Procurement (Preference to Make in India) Order 2017, this Ministry had notified purchase preference (linked with local content) for Hydro and Transmission sectors vide Order No. 11/05/2018-Coord dated 20.12.2018, for Thermal sector vide Order dated 28.12.2018 and for Distribution sector vide Order dated 17.03.2020. Further, a combined order dated 04.04.2020 was also issued in supersession of all previous orders to indicate equipment/material/components for which there was sufficient local capacity and competition and also to indicate conditions for including suitably in the tenders to be issued by the procurers. In furtherance of Para 19 of the DPIIT Notification No. P-45021/2/2017-PP(BE-II) dated 04.06.2020, Ministry of Power (MoP) issued a revised comprehensive Order dated 28.07.2020 (Annexure-I amended by order dated 17.09.2020).

3. DPIIT Notification No. P-45021/2/2017-PP(BE-II) dated 16.09.2020 has further revised its order dated 04.06.2020. Therefore, in supersession of all the aforementioned orders including order No.10/1/2019-St.Th. (Part-II) dated 20.03.2020 issued by this Ministry, the following has been decided:

i. For the purpose of this order, the definitions of various terms used in the order, and provisions relating to (i) Eligibility of 'Class-I local supplier'/'Class-II local supplier'/'Non-local suppliers' for different types of procurement, (ii) purchase preference (iii) exemption to small purchases and (iv) margin of purchase preference shall be the same as in DPIIT order dated 16.09.2020, referred to above and extracts of the same is given at **Appendix**.

ii. In procurement of all goods and services or works in respect of which there is sufficient local capacity and local competition as in **Annexure-I,** only "Class–I local supplier" shall be eligible to bid irrespective of purchase value. "Class-I local supplier" is a supplier or service provider whose goods, services or works offered for procurement meets the Minimum Local Content (MLC) as prescribed in Annexure-I of this order. "Class-II local supplier" means a

supplier, as defined by DPIIT in its Order No. P-45021/2/2017-PP (BE-II) dated 16-09-2020.

iii. In the procurement of all goods and services or works other than those listed in Annexure-I, only "Class-I local supplier" and "Class-II local supplier" as defined in the order of this Ministry herewith shall be eligible to bid in procurement undertaken by procuring entities, except when Global Tender Enquiry has been issued. In Global tender enquiries, "Non-local suppliers" shall also be eligible to bid along with "Class-I local suppliers" and "Class-II local suppliers". In procurement of all goods, services or works not covered by sub-para 3(ii) above, and with estimated value of purchases less than Rs. 200 crores, in accordance with Rule 161(iv) of GFR, 2017, Global Tender Enquiry(GTE) shall not be issued except with the approval of the competent authority as designated by Department of Expenditure.

iv. For the purpose of this order, 'Works' means all works as per Rule 130 of GFR- 2017, and will also include *'turnkey works'*, Engineering, Procurement and Construction (EPC) contracts and service contracts including System Integrator (SI) contracts.

4. The list of items, in respect of which, local capacity with sufficient competition exists as per **Annexure-I,** will be reviewed at regular intervals with a view to increase number of items in this list and also to increase the MLC for each item, wherever it is less than 100%.

5. Purchase preference shall be given to local suppliers in accordance with **para 3A** of DPIIT Order dated 16.09.2020, and extracts of the same are given at **Appendix**.

6. Further, it has been decided to constitute a committee for independent verification of self-declarations and auditor's / accountant's certificates on random basis and in the case of complaints. The composition of the committee is given below:

Member (Planning), Central Electricity Authority (CEA)	Chairperson
Chief Engineer (PSETD), CEA	Member
Chief Engineer (HETD), CEA	Member
Chief Engineer (TETD), CEA	Member
Chief Engineer (DP&R), CEA	Member
As may be co-opted by CEA	External Expert
Chief Engineer (R&D), CEA	Convener

7. Further, it has also been decided to constitute a committee to examine the grievances in consultation with stakeholders and recommend appropriate actions to the Competent Authority in MoP. The composition of the Committee is given below:

Chairperson, CEA	Chairperson
Member (Hydro), CEA	Member

Member (Power System), CEA	Member
Member (Thermal), CEA	Convener

8. The complaint fee of Rs. 2 Lakhs or 1% of the value of the local item being procured (subject to maximum of Rs. 5 Lakhs), whichever is higher, shall be paid in the form of Demand Draft, drawn in favour of **PAO, CEA, New Delhi.** In case the complaint is found to be incorrect, the complaint fee shall be forfeited. In case, the complaint is upheld and found to be substantially correct, the deposited fee of the complainant would be refunded without any interest.

9. All other conditions, not stipulated in this order, shall be as laid down in the DPIIT's order No. P-45021/2/2017-PP (BE-II) dated 16.09.2020.

10. This order shall be applicable in respect of the procurement made by all attached or subordinate offices or autonomous bodies under the Government of India including Government Companies as defined in the Companies Act, and /or the States and Local Bodies making procurement under all Central Schemes/ Central Sector Schemes where the Scheme is fully or partially funded by the Government of India. The aforesaid orders shall also be applicable in respect of projects wherein funding of goods, services or works is by Power Finance Corporation (PFC) /Rural Electrification Corporation (REC) and any Financial Institution in which Government of India/ State Government share exists. This order shall be applicable to Tariff Based Competitive Bidding (TBCB) projects also. Procuring entities as defined in the DPIIT's Order dated 16.09.2020 are advised to revise their tender documents to fully comply with the said DPIIT's Order and the subsequent Orders that would be issued in this regard by DPIIT/ this Ministry from time to time.

11. All tenders for procurement by Central Government Agencies or the States and Local Bodies, as the case may be, have to be certified for compliance of the Public Procurement (Preference to Make in India) 'PPP-MII' Order by the concerned procurement officer of the Government Organization before uploading the same on the portal.

12. Exemption from meeting the stipulated local content is allowed as per clause 13 and 13A of PPP-MII Order dated 16.09.2020, if the manufacturer declares that the item is manufactured in India under a License from a foreign Manufacturer who holds Intellectual Property Rights (IPRs) and there is Transfer of Technology (ToT) with phasing to increase Minimum Local Content. For such items, if any CPSE under the administration of Ministry of Power requests exemption for any item, it shall be considered by Ministry of Power, on case to case basis.

13. In order to further encourage Make in India initiatives and promote manufacturing and production of goods and services in India, general guidelines as enclosed at **Annexure-II** may be adopted in an appropriate manner according to the circumstances by the procuring entities in their tendering process.

14. The procurers may specify the higher values of MLC than those specified in this Order in respect of goods, services or works covered in their tenders and award the weightage to the product of higher MLC for which they have to specify the criteria beforehand in their tender. The values given in Annexure-I are the minimum prescribed values for becoming a class-I local supplier for the products indicated therein.

15. This issues with the approval of Hon'ble Minister for Power and New & Renewable Energy.

(S. Majumdar)
Under Secretary to the Government of India
Tele No. 011- 23356938

To:

1. Secretary to Government of India (All Ministries/ Departments of Government of India) (As per list)
2. Secretary (Coordination), Cabinet Secretariat
3. CEO, NITI Aayog
4. Chief Secretaries of all States/ UTs
5. Comptroller and Auditor General of India
6. Secretary, DPIIT, Chairman of Standing Committee for implementation of Public Procurement Order, 2017
7. Director General, Bureau of Indian Standards (BIS)
8. Joint Secretary, DPIIT, Member-Convener of Standing Committee for implementation of Public Procurement Order, 2017
9. Chairperson, CEA
10. CMDs of CPSEs, CMD NLC, Chairman of DVC/ BBMB/ EESL, DGs of BEE/ CPRI/ NPTI
11. All Additional Secretaries/ JSs/ EA/ CE, Ministry of Power

Copy to:

Director (Technical), NIC with a request to publish the Order on the website of Ministry of Power

APPENDIX

Extracts of important provisions contained in DPIIT Order No. P-45021/2/2017-PP (BE-II) dated 16-09-2020

1. **Definitions** *(Para 2 of DPIIT order)*:
   'Local content' means the amount of value added in India which shall, unless otherwise prescribed by the Nodal Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value, in percent.

   'Class-I local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-I local supplier' under this Order.

   'Class-II local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-II local supplier' but less than that prescribed for "Class-I Local supplier" under this Order.

   'Non-Local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, has local content less than that prescribed for 'Class-II local supplier' under this Order.

   'L1' means the lowest tender or lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation.

   'Margin of purchase preference' means the maximum extent to which the price quoted by a 'Class-I local supplier' may be above the L1 for the purpose of purchase preference.

   'Nodal Ministry' means the Ministry or Department identified pursuant to this order in respect of a particular item of goods or services or works.

   'Procuring entity' means a Ministry or department or attached or subordinate office of, or autonomous body controlled by, the Government of India and includes Government companies as defined in the Companies Act.

   'Works' means all works as per Rule 130 of GFR- 2017, and will also include *'turnkey works'*.

2. **Eligibility of 'Class-I local supplier'/ 'Class-II local supplier'/ 'Non-local suppliers' for different types of procurement** *(Para 3 of DPIIT order)*
   (a) In procurement of all goods, services or works in respect of which the Nodal Ministry / Department has communicated that there is sufficient local capacity and local competition, only 'Class-I local supplier', as defined under the Order, shall be eligible to bid irrespective of purchase value.

   (b) Only 'Class-I local supplier' and 'Class-II local supplier', as defined under the Order, shall be eligible to bid in procurements undertaken by procuring entities, except when Global tender enquiry has been issued. In global tender enquiries, 'Non-local suppliers' shall also be eligible to bid along with 'Class-I local suppliers' and 'Class-II local suppliers'. In procurement of all goods, services or works, not covered by 3(a)above, and with estimated value of purchases less than Rs 200 crores, in accordance with Rule 161(iv) of GFR, 2017 Global tender enquiry shall not

be issued except with the approval of competent authority as designated by Department of Expenditure.

(c) For the purpose of this Order, works includes Engineering, Procurement and Construction (EPC) contracts and services include System Integrator (SI) contracts.

3. **Purchase Preference** *(Para 3A of DPIIT order)*

(a) Subject to the provisions of this Order and to any specific instructions issued by the Nodal Ministry or in pursuance of this Order, purchase preference shall be given to 'Class-I local supplier' in procurements undertaken by procuring entities in the manner specified here under.

(b) In the procurements of goods or works, which are covered by para 3(b) of DPIIT Order No. P-45021/2/2017-PP(BE-II) dated 16-09-2021 and which are divisible in nature, the " Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

i. Among all qualified bids, the lowest bid will be termed as L1 If L1 is 'Class-I local supplier', the contract for full quantity will be awarded to L1.

ii. If L1 bid is not a 'Class-I local supplier', 50% of the order quantity shall be awarded to L1. Thereafter, the lowest bidder among the 'Class-I local supplier' will be invited to match the L1 price for the remaining 50% quantity subject to the Class-I local supplier's quoted price falling within the margin of purchase preference, and contract for that quantity shall be awarded to such 'Class-I local supplier' subject to matching the L1 price. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price or accepts less than the offered quantity, the next higher 'Class-I local supplier' within the margin of purchase preference shall be invited to match the L1 price for remaining quantity and so on, and contract shall be awarded accordingly. In case some quantity is still left uncovered on Class-I local suppliers, then such balance quantity may also be ordered on the L1 bidder.

(c) In the procurements of goods or works, which are covered by para 3(b) of DPIIT Order No. P-45021/2/2017-PP(BE-II) dated 16-09-2021 and which are not divisible in nature, and in procurement of services where the bid is evaluated on price alone, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

iii. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract will be awarded to L1,

iv. If L1 is not 'Class-I local supplier', the lowest bidder among the 'Class-I local supplier', will be invited to match the L1 price subject to Class-I local supplier's quoted price falling within the margin of purchase preference, and the contract shall be awarded to such 'Class-I local supplier' subject to matching the L1 price.

v. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price, the 'Class-I local supplier' with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on and contract shall be awarded accordingly. In case none of the 'Class-I local supplier' within the margin of purchase preference matches the L1 price, the contract may be awarded to the L1 bidder.

(d) "Class-II local supplier" will not get purchase preference in any procurement, undertaken by procuring entities.

4. **Applicability in tenders where contract is to be awarded to multiple bidders** *(Para 3B of DPIIT order)*-
In tenders where contract is to be awarded to multiple bidders subject to matching of L1 rates or otherwise, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:
a) In case there is sufficient local capacity and competition for the items to be procured, as notified by the Nodal Ministry, only 'Class-I local supplier' shall be eligible to bid. As such, the multiple supplier who would be awarded the contract, should be all and only 'Class-I local suppliers'.

   b) In other cases, 'Class-II local suppliers' and 'Non-Local suppliers' may also participate in the bidding process along with 'Class-I local supplier' as per provisions of this order.

   c) If 'Class-I local supplier' qualify for award of contract for at least 50% of the tendered quantity in any tender, the contract may be awarded to all the qualified bidders as per award criteria stipulated in the bid documents. However, in case 'Class-I local supplier' do not qualify for award of the contract for at least 50% of the tendered quantity, purchase preference should be given to the 'Class-I local supplier' over 'Class-II local supplier'/'Non-local suppliers' provided that their quoted rate falls within 20% margin of purchase preference of the highest quoted bidder considered for award of contract so as to ensure that the 'Class-I local suppliers' taken in totality or considered for award of contract for at least 50% of the tendered quantity.

   d) First purchase preference has to be given to the lowest quoting 'Class-I local supplier', whose quoted rates fall within 20% margin of purchase preference subject to its meeting the prescribed criteria for award of contract as also the constraints of maximum quantity that can be sourced from any single supplier. If the lowest quoting 'Class-I local supplier', does not qualify for purchase preference because of aforesaid constraints or does not accept the offered quantity, an opportunity may be given to next higher 'Class-I local supplier' falling within 20% margin of purchase preference, and so on.

   e) To avoid any ambiguity during bid evaluation process, the procuring entities may stipulate its own tender specific criteria for award of contract amongst different bidders including the procedure for purchase preference to 'Class-I local supplier' within the broad policy guidelines stipulate in sub-paras above.

5. **Exemption of small purchases** *(Para 4 in DPIIT order)*: Procurements where the estimated value to be procured is less than Rs. 5 lakhs shall be exempt from this Order. However, it shall be ensured by procuring entities that procurement is not split for the purpose of avoiding the provisions of this Order.

6. **Minimum Local Content** *(Para 5 in DPIIT order)*: The 'local content' requirement to categorize a supplier as 'Class-I local supplier' is minimum 50%. For 'Class-II local supplier', the local content requirement is minimum 20%. Nodal Ministry/Department may prescribe only a higher percentage of minimum local content requirement to categorize a supplier as 'Class-I local supplier'/'Class-II local supplier'. For the item for which Nodal Ministry/Department has not prescribed higher minimum local content notification under the order, it shall be 50% and 20% for 'Class-I local supplier'/'Class-II local supplier' respectively.

7. Vide DPIIT OM No. P-45021/102/2019-BE-IIPart(1) (E-50310) dated 4.03.2021 services such as transportation, insurance, installation, commissioning, training and after sales service support like AMC/CMC etc. shall not be considered as local value addition. Bidders offering imported products will fall under the category of Non- local suppliers. They can't claim themselves as Class-I local suppliers/Class-II local suppliers by claiming the services such as transportation, insurance, installation, commissioning, training and after sales service support like AMC/CMC etc. as local value addition.

8. **Margin of Purchase Preference** *(Para 6 of DPIIT order)*: The margin of purchase preference shall be 20%.

9. **Specifications in Tenders and other procurement solicitations** *(Para 10 of DPIIT order)*:
   a. Every procuring entity shall ensure that the eligibility conditions in respect of previous experience fixed in any tender or solicitation do not require proof of supply in other countries or proof of exports.
   b. Procuring entities shall endeavour to see that eligibility conditions, including on matters like turnover, production capability and financial strength do not result in unreasonable exclusion of 'Class-I local supplier'/ 'Class-II local supplier' who would otherwise be eligible, beyond what is essential for ensuring quality or creditworthiness of the supplier.
   c. Procuring entities shall, within 2 months of the issue of this Order review all existing eligibility norms and conditions with reference to sub-paragraphs 'a' and 'b' above.
   d. **Reciprocity Clause:**
      i. When a Nodal Ministry/Department identifies that Indian suppliers of an item are not allowed to participate and/ or compete in procurement by any foreign government, due to restrictive tender conditions which have direct or indirect effect of baring Indian companies such as registration in the procuring country, execution of projects of specific value in the procuring country etc. it shall provide such details to all its procuring entities including CMDs/CEOs of PSEs/PSUs, State Governments and other procurement agencies under their administrative control and GeM for appropriate reciprocal action.
      ii. Entities of countries which have been identified by the nodal Ministry/Department as not allowing Indian companies to participate in their Government procurement for any item related to that nodal Ministry shall not be allowed to participate in Government procurement in India for all the items related to that nodal Ministry/Department, except for the list of items published by the Ministry/Department permitting their participation.
      iii. The stipulation in (ii) above shall be part of all tenders invited by the Central Government procuring entities stated in (i) above. All purchase on GeM shall also necessarily have the above provisions for items identified by nodal Ministry/Department.
      iv. State Governments should be encouraged to incorporate similar provisions in their respective tenders.
      v. The term 'entity' of a country shall have the same meaning as under the FDI Policy of DPIIT as amended from time to time.
   e. Specifying foreign certification/ unreasonable technical specifications/ brands/ models in the bid document is restrictive and discriminatory practice against local

suppliers. If foreign certification is required to be stipulated because of non-availability of Indian Standards and/ or for any other reason, the same shall be done only after written approval of Secretary of Department concerned or any other authority having been designated such power by the Secretary of the Department concerned.

f. "All administrative Ministries/Departments whose procurement exceeds Rs. 1000 Crore per annum shall notify/ update their procurement projections every year, including those of PSEs/PSUs, for the next 5 years on their respective website."

Annexure-I

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficent local capacity and competition	Class-I Local Supplier (Minimum Local Content (%)
	(A) Common items for Transmission, Distribution and Generation Sector	
1	Power Transformers (up to 765 kV, including Generator transformers)	60
2	Instrument Transformer (up to 765 kV)	60
3	Transformer Oil Dry Out System (TODOS)	60
4	Reactors up to 765 kV	60
5	Oil Impregnated Bushing (up to 400 kV)	60
6	Resin Insultated Paper (RIP) bushings (up to 145 kV)	50
7	Circuit Breakers (up to 765 kV AC - Alternating Current)	60
8	Disconnectors/Isolators (up to 765 kV AC)	60
9	Wave trap (up to 765 kV AC)	60
10	Oil Filled Distribution Transformers up to & Including 33 kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound]	60
11	Dry Type Distribution Transformer upto and including 33 kV (CRGO/Amorphous, Aluminium/Copper wound)	60
12	Conventional Conductor	60
13	Accessories for Conventional conductors	60
14	High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and Accessories	60
15	Optical ground wire (OPGW) – all designs	60
16	Fiber OpticTerminal Equipment (FOTE) for OPGW	50
17	OPGW related Hardware and Accessories	60
18	Remote Terminal Unit (RTU)	50
19	Power Cables and accessories up to 33 kV	60
20	Control cables including accessories	60
21	XLPE Cables up to 220 kV	60
22	Substation Structures	60
23	Transmission Line Towers	60
24	Porcelain (Disc/Long Rod) Insulators	60
25	Bus Post Insulators (Porcelain)	60
26	Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating	50
27	Porcelain Longrod Insulators withRoom Temperature Vulcanisation (RTV) coating	50
28	Hardware Fittings for Porcelain Insulators	60
29	Composite/Polymeric Long Rod Insulators	60
30	Hardware Fittings for Polymer Insulators	60
31	Bird Flight Diverter (BFD)	60
32	Power Line Carrier Communication (PLCC) System (up to 800 kV)	60
33	Gas Insulated Switchgear (up to 400 kV AC)	60
34	Gas Insulated Switchgear (above 400 kV AC)	50
35	Surge/Lightning Arrester (up to 765 kV AC)	60
36	Power Capacitors	60
37	Packaged Sub-station (6.6 kV to 33 kV)	60
38	Ring Main Unit (RMU) (up to 33 kV)	60
39	Medium Voltage (MV) GIS Panels (up to 33 kV)	60
40	Automation and Control System/Supervisory Control and data Acquisition (SCADA) System in Power System	50
41	Control and Relay Panel (including Digital/Numerical Relays)	50
42	Electrical Motors 0.37 kW to 1 MW	60
43	Energy Meters excluding smart meters	50
44	Control & power cables and Accessories (up to 1.1 kV)	60
45	Diesel Generating (DG) set	60

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficent local capacity and competition	Class-I Local Supplier (Minimum Local Content (%)
46	DC system (DC Battery & Battery Charger)	60
47	AC & DC Distribution Board	60
48	Indoor Air Insulated Switchgear (AIS) upto 33 kV	60
49	Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular)	60
50	Material for Grounding/earthing system	60
51	Illumination system	60
52	Overhead Fault Sensing Indicator (FSI)	50
53	Power Quality Meters	50
54	Auxilliary Relays	50
55	Load Break Switch	50
	(B) Hydro Sector	
56	Hydro Turbine & Associated equipment	
	a) Francis Turbine	60
	b) Kaplan Turbine	60
	c) Pelton Turbine	50
57	Main Inlet Valve & Associated Equipment	60
58	Penstock Protection Valve and Associated Equipment	60
59	Governing system & Accessories	60
60	Generator for Hydro Project & Associated Equipment	60
61	Static Excitation System	60
62	Workshop Equipment	60
63	Cooling Water System	60
64	Compressed Air System	60
65	Drainage/Dewatering System	60
66	Fire Protection System	60
67	Heating, Ventilation & Air Conditioning System (HVAC)	60
68	Oil Handling System	60
69	Mechanical Balance of Plant (BOP) Items	60
	(C) Thermal Sector	
	Boiler Auxiliaries	
70	Air Pre-Heater	60
71	Steam Coil Air Pre Heater (SCAPH)	60
72	Steam soot blowers [wall blowers & Long Retractable Soot Blower (LRSB)]	60
73	Auxiliary Steam Pressure Reducing & Desuperheating (PRDS)	60
74	Fuel oil system	60
75	Seal air Fan	60
76	Ducts and dampers	60
77	Duct expansion joints	60
78	Blowdown tanks	60
79	Coal burners and oil burners	60
80	Coal mills	60
81	Gear Box of Coal Mill	50
82	Coal feeders	60
83	Primary Air Fans	60
84	Forced Draft Fans	60
85	Induced Draft Fans	60
86	Forced Draft (FD)/Induced Draft (ID)/ Primary Air (PA) Fan Servo Motor Assembly	50
87	Tubes (Carbon Steel)	50
88	Steam pipes (Carbon Steel)	50
89	Steam drum	50
90	Separator	50
91	Selective Catalytic Reduction (SCR)	50

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficent local capacity and competition	Class-I Local Supplier (Minimum Local Content (%)
	Electro-Static Precipitators (ESPs)	
92	Casing	60
93	Electrodes	60
94	Rapping System	60
95	Hopper Heaters	60
96	Transformer Rectifiers	60
97	Insulators	60
	Turbine & Auxiliaries	
98	Turbine (High Pressure/Intermediate Pressure/Low Pressure)	50
99	Condensate Extraction Pumps	60
100	Condenser On line Tube Cleaning System (COLTC)	60
101	Debris filters	60
102	Deaerator	60
103	Drain Cooler and Flash Tank	60
104	ECW Pump	50
105	Plate Heat Exchanger	50
106	Self- cleaning filters	50
107	Condensate Polishing Units (CPUs)	60
108	Chemical Dosing System	60
109	Oil Filter	60
110	Gland Steam Condenser	60
111	Oil Purifying Centrifuge	50
112	Water Cooled Condenser	50
113	Boiler Feed Pumps (BFPs)	50
	Generator and Auxillieries	
114	Generator (including Seal Oil System, Hydrogen Cooling System, Stator water cooling system)	60
	Electrical Works	
115	Control and metering equipment	60
	Control & Instrumentation System (C&I System)	
116	Thermocouples	50
117	Measuring instruments [Resistance Temperature Detectors (RTDs)], Local gauges	50
118	Actuators (Pneumatic and conventional electric)	50
119	Interplant Communication/ Public Address (PA) system except IP based	50
	Coal Handling Plant	
120	Conveyors	60
121	Wagon Tippler	60
122	Side Arm Charger	60
123	Paddle feeder	60
124	Crushers & Screens	60
125	Dust suppression (dry fog & plain water) system	60
126	Air Compressors	50
127	Magnetic separators & metal detectors	60
128	Coal Sampling System	60
129	Stacker cum reclaimer	60
130	Belt weighing & monitoring system.	60
131	Wheel & axle assembly (without bearings) for Bottom Opening Bottom Release (BOBR) Wagons	60
	Ash Handling System	
132	Clinker grinder	60
133	Water jet ejectors	60
134	Scrapper chain conveyor	60
135	Dry fly ash vacuum extraction system	60
136	Pressure pneumatic conveying system	60

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficent local capacity and competition	Class-I Local Supplier (Minimum Local Content (%)
137	Ash water & ash slurry pumps	60
138	Compressors, air dryers & air receivers	50
139	Ash water recovery system	60
	Raw Water Intake & Supply System	
140	Travelling water screens	60
141	Raw water supply pumps	60
142	Valves, RE joints etc.	60
	Water Treatment System and Effluent Treatment System	
143	Clarification plant	60
144	Filtration plant	60
145	Ultra filtration plant	50
146	Reverse Osmosis (RO) plant and its membrane	55
147	De-Mineralised water plant (DM Plant)	60
148	Chlorination plant	60
149	Chemical dosing system	60
150	Effluent Treatment Plant	60
	Circulationg Water (CW) & Auxiliary Circulating Water (ACW) System	
151	CW & ACW Pumps	60
152	Butter Fly (BF) valves, Non-return Valves (NRVs) etc.	60
153	Rubber Expansion (RE) joints	60
154	Air release valves	60
	Cooling Towers (NDCT/ IDCT)-Natural-Draft and Induced Draft Cooling Tower	
155	Water Distribution System	60
156	Spray nozzles	60
157	Packing	60
158	Drift eliminators	60
159	Cooling Tower (CT) Fans (for Induced Draft Cooling Towers IDCT)	60
160	Gear boxes, shafts & motors (for IDCT)	60
	Air Conditioning & Ventilation System	
161	Split & window air conditioners	60
162	Chilling/ condensing unit [upto 500 ton of refrigeration(TR)]	55
163	Air Handling Unit (AHU) and Fresh air unit	60
164	Cooling Towers	60
165	Air Washing Units (AWUs), axial fans, roof extractors	60
166	Ducts, louvers & dampers	60
	Flue Gas Desulphurization (FGD)	
167	Spray Nozzles,	50
168	Spray header	50
169	Oxidation Blowers	50
170	Limestone wet Ball Mill	50
171	Slurry Handling Pumps for FGD system	50
172	Booster Fans for FGD system	50
173	Carbon Steel Ducts and Dampers for FGD	60
174	Storage Tanks and Silos	60
175	Process Water Pump for FGD system	50
	(D) Other Common Items	
	Fire protection and detection system	
176	Motor driven fire water pumps	60
177	Diesel engine driven fire water pumps	60
178	Hydrant system for the power plant.	60
179	High velocity water spray system	60
180	Medium velocity water spray system	60
181	Foam protection system	60
182	Inert gas flooding system	60

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficent local capacity and competition	Class-I Local Supplier (Minimum Local Content (%)
183	Fire tenders	60
184	Portable fire-extinguishers	60
185	Cranes, EOT cranes, gantry crane & chain pulley blocks etc.	60
186	Elevator	60

(E) Minimum Local Content percentages in Engineering, Procurement & Construction (EPC) / Turnkey project

In case the contract is awarded through the EPC route, the contractor should comply with the requirement of MLC for individual items as listed in Annexure-I and should purchase these items only from Class-I Local supplier. In addition, MLC for complete EPC project may also be prescribed as below:

	(1) Package Based Works	Minimum Local Content (%)
1	Boiler	60
2	TG System (Water Cooled Condenser)	60
3	Ash Handling Plant	60
4	Coal Handling Plant	60
5	Electro-static Precipitator (ESP)	60
6	Circulating Water (CW) System	60
7	Cooling Tower	60
8	Water Treatment System	60
9	Air Conditioning System (below 500TR)	60
10	Flue Gas Desusphurisation (FGD) System	60
11	Station Control & Instrumentation (C&I)	50
12	Hydro Power Projects (Electro-Mechanical Works)	60
	Gas based generation	
	Overall Gas Turbine Package (on finished Product basis)	
13	< 44 MW	60
14	44 –145 MW	50
	Overall Combined Cycle Gas Turbine (CCGT) Package (on finished Product basis)	
15	< 44 MW	60
16	44 – 145 MW	60
17	> 150 MW	60
	(2) Project as a whole	
1	Works and service contracts in Power Sector	60
2	Transmission Line with Conventional conductors (ACSR, AAAC, AL-59 etc.)	60
3	Transmission Line with High temperature Low Sag (HTLS) conductors	60
4	HVAC Substation Air Insulated (AIS)	60
5	HVAC Substation Gas Insulated (GIS)	60
6	HVDC Substation	60
7	Distribution Sector	60

Annexure-II

General guidelines to be adopted selectively in an appropriate manner by the procuring entities in their tender documents.

1. The bidder shall have to be an entity registered in India in accordance with law.
2. The bids shall be in the language as prescribed by the tenderer/procurer.
3. The bids shall be in Indian Rupees (INR) (in respect of local content only).
4. Indian subsidiaries of foreign bidders shall have to meet the qualifying criteria in terms of capability, competency, financial position, past performance etc.
5. The bidder shall follow Indian laws, regulations and standards.
6. To be eligible for participation in the bid, foreign bidders shall compulsorily set up their manufacturing units on a long term basis in India as may be specified by the tenderer/ procurer.
7. Similar or better technology than the technology offered in respect of material, equipment and process involved shall be transferred to India. Along with the transfer of technology, adequate training in the respective field shall also be provided.
8. Country of origin of the equipment/material shall be provided in the bid.
9. For supply of equipment / material from the country of origin other than India, the bidder shall submit performance certificate in support of satisfactory operation in India or a country other than the country of origin having climatic and operational conditions including ambient temperature similar to that of India for more than _____ years (to be specified by the procurer).
10. The technologies/ products offered shall be environmental friendly, consuming less energy, safe, energy efficient, durable and long lasting under the prescribed operational conditions.
11. The supplier shall ensure supply of spares, materials and technological support for the entire life of the project.
12. The manufacturers/ supplier shall list out the products and components producing Toxic E-waste and other waste as may be specified. It shall have an Extended Producers Responsibility (EPR) so that after the completion of the lifecycle, the materials are safely recycled / disposed of by the Manufacturer/ supplier and for this, the Manufacturer/supplier along with procurer has to establish recycling / disposal unit **or** as may be specified.
13. Minimum Local Content requirement for goods, services or works shall be in accordance with the conditions laid down in respective Order(s) of the sectors on Public Procurement (Preference to Make in India) to provide for purchase preference (linked with local content).

14. The equipment/ material sourced from foreign companies may be tested in accredited labs in India before acceptance wherever such facilities are available.
15. The Tender fee and the Bank Guarantee (BG) shall be in Indian Rupees only.
16. The bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/process to be supplied/services to be rendered as safe to connect.
17. Applicable safety requirements shall be met. Regular safety audit shall be carried out by the manufacturer/ supplier.
18. Statutory laws/regulations including the labour and environmental laws shall be strictly complied with during supply, storage, erection, commissioning and operation process. A regular compliance report shall be submitted to the procurer/appropriate Authorities.
19. Formation of new joint venture in India shall be permitted only with the Indian companies.
20. Tendering by the agent shall not be accepted.
21. In case local testing is not considered necessary by the procurer, theoriginal test report in the language prescribed by the procurer may be accepted. The translated test report shall not be accepted unless it is notarised.
22. Certification/compliance as per the Indian Standards/ International Standards/ Indian Regulations/ specified Standards shall be mandatory, where ever applicable.
23. Quality assurance of the product shall be carried out by the procurer or an independent third party agency appointed by the procurer. Manufacturing Quality Plan as approved by the procurer shall be followed by the manufacturer/supplier.
24. Wherever required by the procurer, foreign supplier shall establish fully functional service centers in India and shall keep spares/material locally for future needs of utilities.
25. Arbitration proceedings shall be instituted in India only and all disputes shall be settled as per applicable Indian Laws.

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1

IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform-ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957

IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocrystallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	

IS:4540	Specification for monory-stallines rectifire assembly equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	
IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
IS:7938	Air receivers for compressed air installation	
ISO:1217	Displacement compressor-Acceplance test	
ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling	
ASHRAE-52-76 particle matter.	Air cleaning device used in general ventilation for removing	

ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435 BS:848 (Part-1,2)	Central station AHU/Application of Central Station AHU Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquified gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC- 23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinary services.

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

IS: 4701	Code of practice for earth work on canals.
IS: 9758	Guidelines for Dewatering during construction.
IS: 10379	Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269	Specification for ordinary Portland cement, 33 grade.
IS: 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS: 432	Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.
IS: 455	Specification for Portland slag cement.
IS: 702	Specification for Industrial bitumen.
IS: 712	Specification for building limes.
IS: 808	Rolled steel Beam channel and angle sections.
IS: 1077	Specification for common burnt clay building bricks.
IS: 1161	Specification of steel tubes for structural purposes.
IS: 1363	Hexagon head Bolts, Screws and nuts of production grade C.
IS: 1364	Hexagon head Bolts, Screws and Nuts of Production grade A & B.
IS: 1367	Technical supply conditions for Threaded fasteners.

IS: 1489	Specification for Portland-pozzolana cement:
(Part-I)	Fly ash based.
(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.
IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.
IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS: 8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

Cast-In-Situ Concrete and Allied Works

IS: 280	Specification for mild steel wire for general engineering purposes.
IS: 456	Code of practice for plain and reinforced concrete.
IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
IS: 516	Method of test for strength of concrete.
IS: 650	Specification for standard sand for testing of cement.
IS: 1199	Methods of sampling and analysis of concrete.
IS: 1791	General requirements for batch type concrete mixers.
IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
IS: 2204	Code of practice for construction of reinforced concrete shell roof.
IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS: 2438	Specification for roller pan mixer.
IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS: 2505	General requirements for concrete vibrators, immersion type.
IS: 2506	General requirements for concrete vibrators, screed board type.
IS: 2514	Specification for concrete vibrating tables.
IS: 2645	Specification for Integral cement water proofing compounds.
IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
IS: 2750	Specification for Steel scaffolding.

IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS: 3025	Methods of sampling and test waste water.
IS: 3366	Specification for Pan vibrators.
IS: 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558 concrete.	Code of practice for use of immersion vibrators for consolidating
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326 of buildings.	Code of practice for earthquake resistant design and construction
IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.
IS: 4990	Specification for plywood for concrete shuttering work.
IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.

IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.
IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.
Part-2	Rebound hammer.
SP:23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/ prefabrication and Sec.7)	National Building Code- Structural design of systems building.

IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonary and Allied Works

IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.
IS: 2212	Code of Practice for Brickwork.
IS: 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP: 20	Explanatory handbook on masonry code.

Sheeting Works

IS:277	Galvanised steel sheets (plain or corrugated).
IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.
IS: 513	Cold-rolled carbon steel sheets.
IS: 730	Specification for fixing accessories for corrugated sheet roofing.
IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS: 3007	Code of practice for laying of asbestos cement sheets.
IS: 5913	Methods of test for asbestos cement products.
IS: 7178	Technical supply conditions for tapping screw.
IS: 8183	Bonded mineral wool.

IS: 8869	Washers for corrugated sheet roofing.
IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS: 12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.

Fabrication and Erection of Structural Steel Work

IS: 2016	Specification for plain washers.
IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.
IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.

IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Handbook for structural Engineers.
IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.
IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copper alloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.
IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.

	IS : 1742	Code of practice for building drainage.
	IS : 1795	Pillar taps for water supply purposes.
	IS : 1879	Malleable cast iron pipe fittings.
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.
	IS : 2065	Code of practice for water supply in building.
	IS : 2326	Automatic flushing cisterns for urinals.
	IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
	IS : 2501	Copper tubes for general engineering purposes.
	IS : 2548	Plastic seat and cover for water-closets.
	IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
	IS : 2963	Non-ferrous waste fittings for wash basins and sinks.
	IS : 3114	Code of practice for laying of cast iron pipes.
	IS : 3311	Waste plug and its accessories for sinks and wash basins.
	IS : 3438	Silvered glass mirrors for general purposes.
	IS : 3486	Cast iron spigot and socket drain pipes.
	IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
	IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
	IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
	IS : 4127	Code of practice for laying of glazed stone-ware pipes.

IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.
IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP: 35	Handbook on water supply and drainage.
-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.